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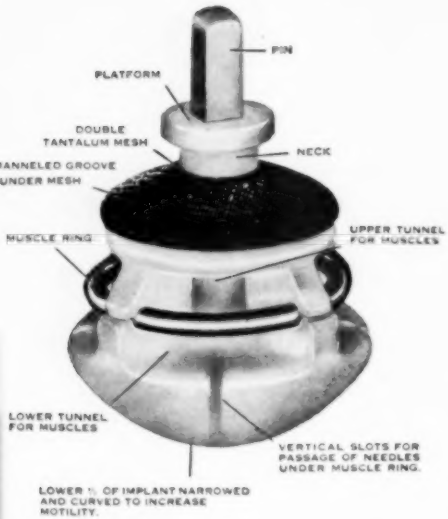

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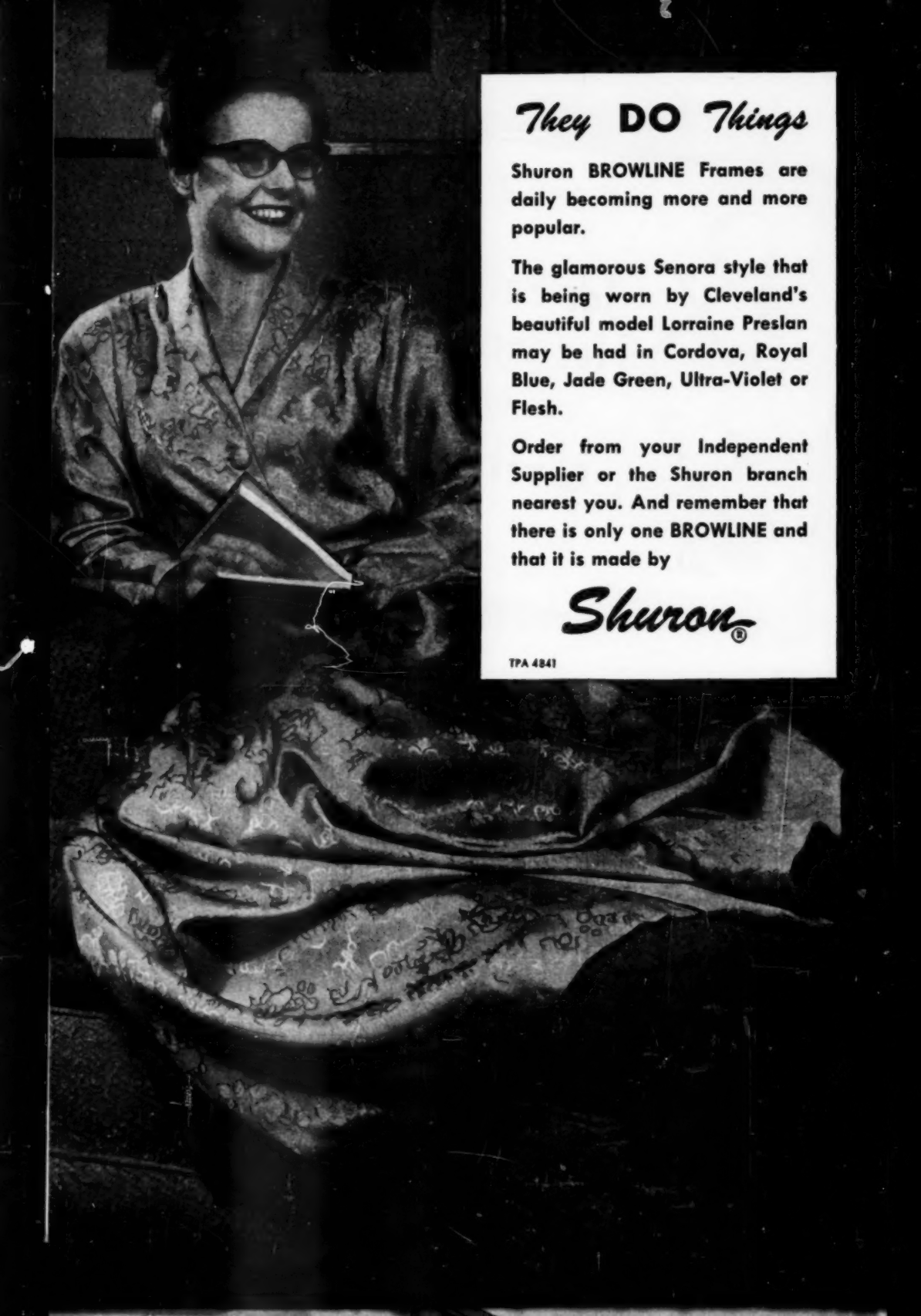

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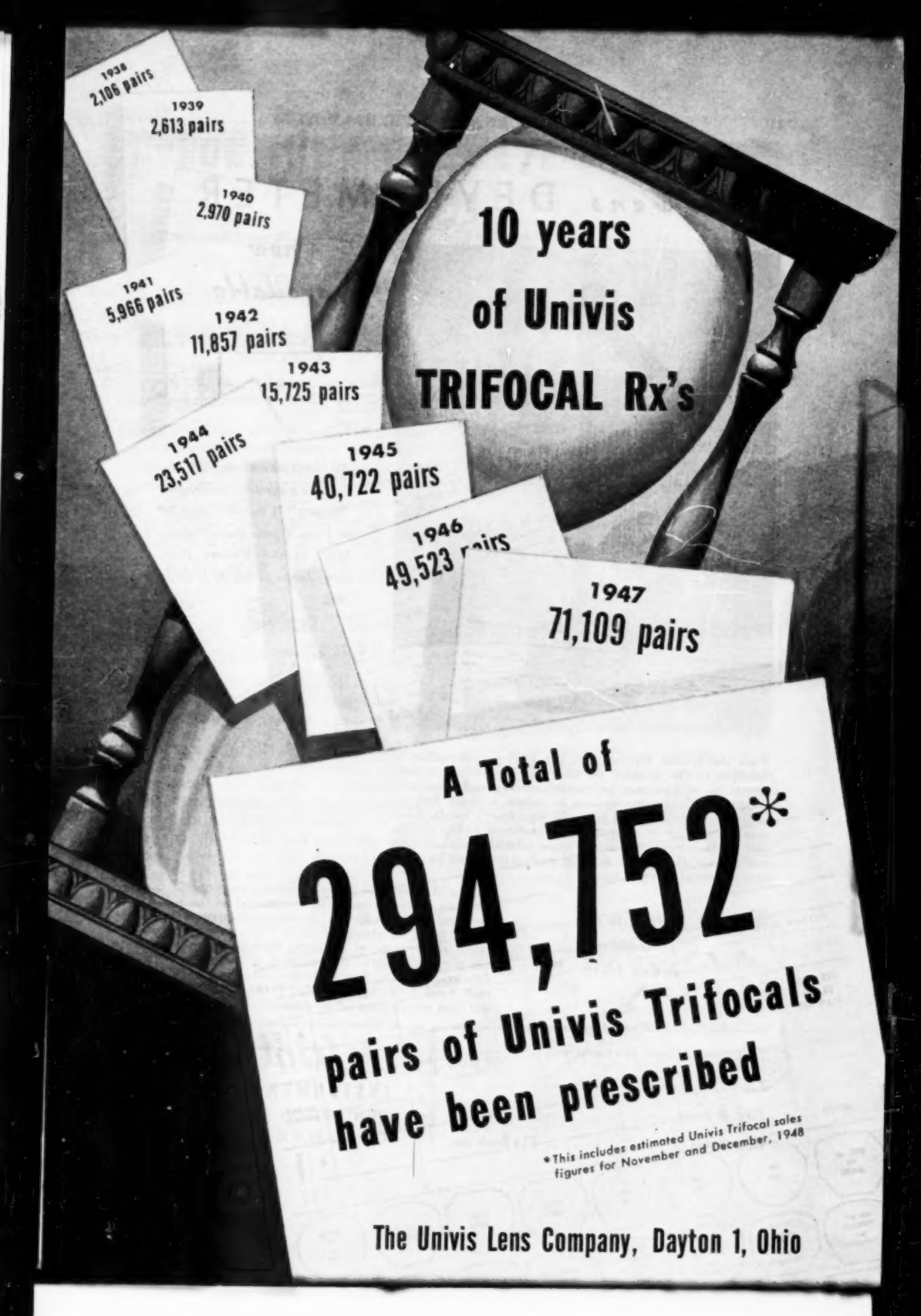
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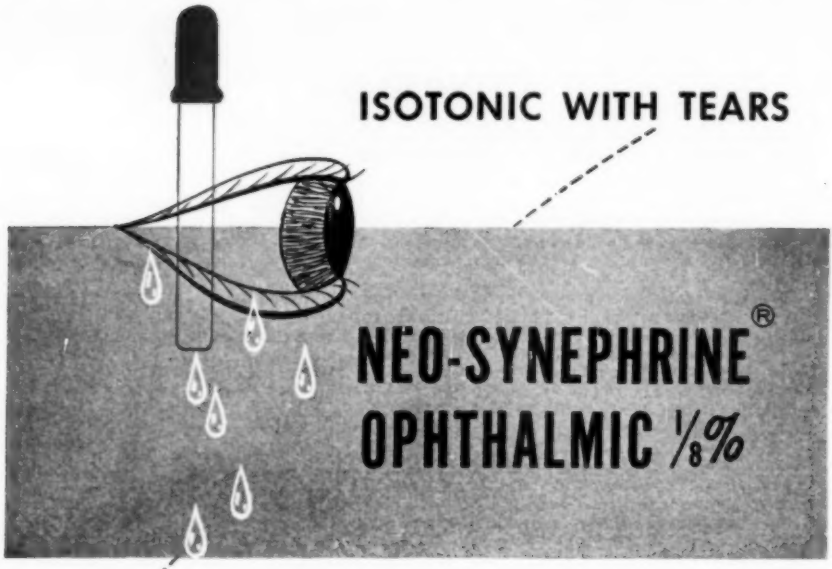

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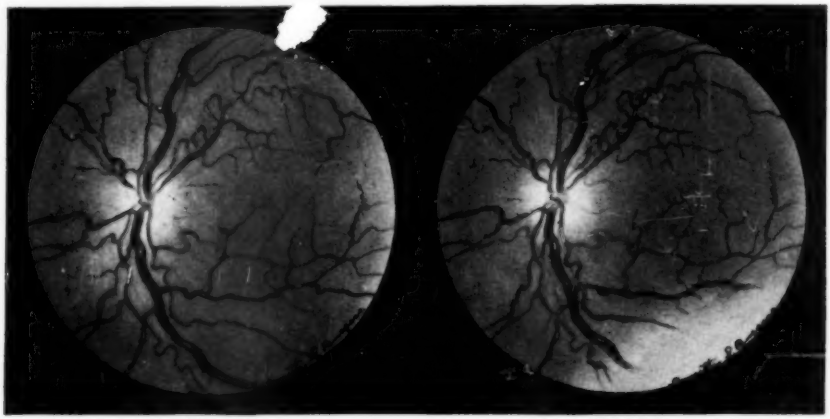

Fig. 1

Fig. 2

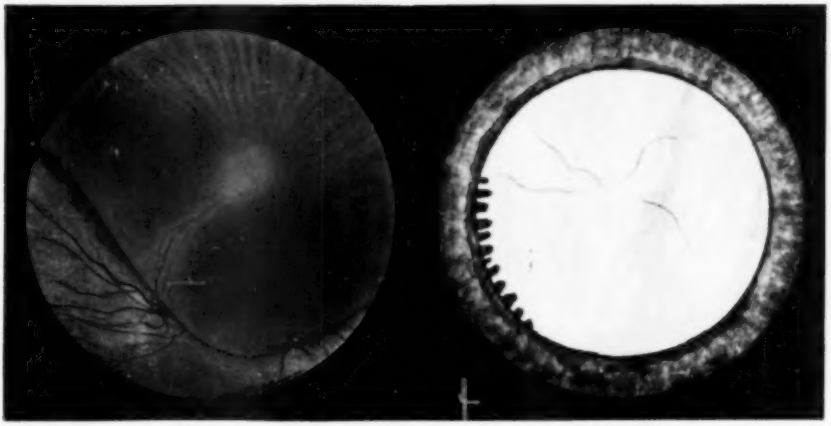

Fig. 3

Fig. 4

FIGS. 1 TO 4 (OWENS AND OWENS). (FIG. 1) AN EARLY STAGE OF THE DISEASE SHOWING DILATED AND TORTUOUS RETINAL VESSELS (CASE 4, LEFT EYE). (FIG. 2) INFILTRATIVE STAGE SHOWING EDEMA OF THE DISC AND EXUDATIVE MASS IN THE PERIPHERY OF THE RETINA (CASE 4, LEFT EYE). (FIG. 3) ANTERIOR PORTION OF INFILTRATED RETINA APPEARING AS A MEMBRANE AT THE PERIPHERY OF THE RETROLENTAL SPACE (CASE 9, RIGHT EYE). (FIG. 4) COMPLETE RETROLENTAL MEMBRANE WITH CILIARY PROCESSES AND VESSELS ON THE MEMBRANE (CASE 1, LEFT EYE).

AMERICAN JOURNAL OF OPHTHALMOLOGY

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RETROLENTAL FIBROPLASIA IN PREMATURE INFANTS*

WILLIAM COUNCILMAN OWENS, M.D., AND ELLA UHLER OWENS, M.D.
Baltimore, Maryland

In 1942 Terry[1] described a disease occurring in premature infants in which an opaque tissue forms behind the lens after birth. He called this disease retrolental fibroplasia. In the fully developed stage of a typical case, an opaque, vascularized membrane lies against the posterior surface of the lens. The globe is often smaller than normal, the anterior chamber is frequently shallow, and occasionally posterior synechias form. Elongated ciliary processes, appearing like coarse teeth of a comb, can be seen behind the iris on the membrane in the extreme periphery of the dilated pupil. In premature infants, both eyes are usually involved but not always to the same extent. In some eyes, the retrolental membrane may be incomplete and cover only a localized portion of the retrolental space. In others, the membrane may be limited to the periphery of the anterior vitreous at the equator of the lens. In these cases, a localized detachment of the retina often extends into the membrane.

There has been considerable discussion as to the nature of this disease. Terry proposed the idea that the basis of the disease lay in the development of embryonic connective tissue in the meshwork of a persistent tunica vasculosa lentis. In pursuance of his theory, Terry made extensive studies on the development and regression of the hyaloid system and attempted, but without success, to reproduce the disease by experiments[6-9] on the hyaloid artery and tunica vasculosa lentis in young opossums and rats.

Reese and Payne[3] suggested the term "persistence and hyperplasia of the primary vitreous" as a better designation for the lesion. They advanced the idea that the retrolental membrane represented hyperplastic remnants of the primary vitreous, which they described as an angioblastic mesoderm that included the hyaloid system. In their description of the clinical manifestations of the disease, they included eyes with isolated remains of either the retrolental or the posterior portions of the hyaloid system. They thought the disease was congenital, differing with Terry who believed it developed after birth.

Krause[2] thought that the disease was part of a syndrome which he called "congenital encephalo-ophthalmic dysplasia" and that the essential lesion was a prenatal abnormality of the cerebral and retinal neuroectoderm. He expressed the opinion that the hyperplasia of connective tissue surrounding a persistent hyaloid artery, occasionally seen as a unilateral lesion in full-term infants, was not part of this disease. He considered the disease to be a general pathologic process characterized by retinal and cerebral hypoplasia and hyperplasia.

Many unsettled problems exist in the study of retrolental fibroplasia. Thus far reports have been limited almost entirely to clinical and pathologic examination made when the disease was far advanced. None

* From the Wilmer Ophthalmological Institute of The Johns Hopkins Hospital and University. Presented at the 53rd annual session of the American Academy of Ophthalmology and Otolaryngology, October, 1948, Chicago, Illinois.

gives the full course of the disease, since the earliest stages and development of the disease have not been observed. A controversy exists as to whether the disease is always present at birth and is overlooked until later, or whether it may develop in postnatal life. The relationship of the retrolental mass to the primary vitreous and hyaloid system has not been settled.

In July, 1945, we began a study to determine the incidence of retrolental fibroplasia and to observe the course of the disease. From July, 1945, to June, 1947, we examined routinely the premature infants born on the obstetrical service of the Johns Hopkins Hospital or admitted to the premature nursery of the pediatric service. Our plan was to examine all infants weighing 2000 gm. (4½ lb.) or less at monthly intervals from birth until the age of six months, and at bimonthly intervals from the age of six months to a year. Although a birth weight of 2500 gm. (5½ lb.) or less is usually accepted as the criterion of prematurity, our routine examinations were made only on infants whose birth weight was 2000 gm. (4½ lb.) or less. This limit was chosen because of the large number of infants, and the relative infrequency of retrolental fibroplasia, in the group whose birth weight was between 2000 gm. (4½ lb.) and 2500 gm. (5½ lb.)

TABLE 1

DISTRIBUTION OF BIRTH WEIGHTS OF PREMATURE INFANTS BORN BETWEEN 1935 AND 1944 WHO RETURNED FOR EXAMINATION

Birth weight less than 1,360 grams

Grams	No.
800– 899	1
900– 999	3
1000–1099	1
1100–1199	7
1200–1299	5
1300–1359	6
	23

Birth weight 1,360 grams and over

Grams	No.
1360–1399	3
1400–1499	15
1500–1599	15
1600–1699	13
1700–1799	17
1800–1899	19
1900–2000	15
	97

Total—120

INCIDENCE

The only statement on the incidence of retrolental fibroplasia in the literature is that given by Terry. In reporting a personal communication from Dr. Stewart Clifford of the pediatrics staff of the Boston Lying-In Hospital, Terry[8] stated that Dr. Clifford had found the disease occurring in 12 percent of infants weighing 3 pounds or less at birth, a percentage "based on less than 50 cases."

Two methods of approach were used in our study of the incidence. First an attempt was made to determine the incidence of retrolental fibroplasia in the 10-year period prior to the time we began our study, that is, from 1935 to 1944. From the hospital records of births during that period, we obtained a list of the infants born prematurely with birth weights of 2000 gm. (4½ lb.) or less. Letters were sent to the parents of 328 of these children. One hundred and twenty children, ranging from 1 to 8 years of age, returned to the hospital for examination. None had retrolental fibroplasia. The distribution of these children grouped by birth weights is shown in Table 1. Ninety-seven had weighed from 1360 gm. (3 lb.) to 2000 gm. (4½ lb.) at birth, and 23 had weighed less than 1360 gm. (3 lb.) at birth.

Second, the incidence of retrolental fibroplasia was determined in the current group of premature infants. From July, 1945, to June, 1947, we followed from birth 214 premature infants born on the obstetrical service or admitted to the premature nursery of the pediatric service. Forty of these weighed less than 1360 gm. (3 lb.) and 174 weighed from 1360 gm. (3 lb.) to 2000 gm.

(4½ lb.) at birth. None of these infants had retrolental fibroplasia at birth.

Since retrolental fibroplasia has not been reported to occur after the age of six months, this period of observation was considered adequate for evaluation of the incidence. We followed 111 of the infants for six months or more. Thirty-three of them weighed less than 1360 gm. (3 lb.) at birth, and 4 in this weight group developed retrolental fibroplasia. Seventy-eight of the infants weighed from 1360 gm. (3 lb.) to 2000 gm. (4½ lb.) at birth, and 1 in this weight group developed retrolental fibroplasia. Thus the incidence of retrolental fibroplasia was 12.1 percent in the very premature group, weighing less than 3 pounds, and 1.3 percent in the group weighing from 3 to 4½ pounds. The distribution of these children grouped by birth weights is shown in Table 2. By far the greater incidence of retrolental fibroplasia occurred in the very premature group of infants.

TABLE 2

DISTRIBUTION OF BIRTH WEIGHTS OF PREMATURE INFANTS BORN BETWEEN 1945 AND 1947 IN GROUP UNDER OBSERVATION

Grams	No.	Cases of Retrolental Fibroplasia
Birth weight less than 1,360 grams		
800– 899	1	0
900– 999	2	1
1000–1099	5	0
1100–1199	10	1
1200–1299	8	2
1300–1360	7	0
	33	4
Birth weight 1,360 grams and over		
1360–1399	0	0
1400–1499	8	0
1500–1599	12	0
1600–1699	8	1
1700–1799	11	0
1800–1899	11	0
1900–2000	28	0
	78	1
	Total—111	

EARLY PICTURE AND COURSE OF RETROLENTAL FIBROPLASIA

One of our first problems was to establish the clinical course of the disease since no observations had been reported on the early stages of its development. As stated above, none of the 214 premature infants in our study had retrolental fibroplasia at birth. In numerous very premature infants, remnants of the posterior portion of the tunica vasculosa lentis and extensive pupillary membranes were seen at birth. In all the cases observed these vessels disappeared.

During this study we observed retrolental fibroplasia develop in nine cases. In some cases we were able to follow the course of the disease from its earliest stages to the final development of the retrolental membrane. In others we made our first observations at various intermediate stages and were able to follow the course from that stage onward. Five of these cases occurred in children observed during our routine study to determine the incidence, and 4 have occurred since that phase of the study was completed. In 1 premature infant (case 4), we observed early fundus changes identical with those of the 9 infants who subsequently developed retrolental fibroplasia. However, in this child the fundus changes regressed and no retrolental membrane formed.

The general course of the development of retrolental membranes in these premature infants was as follows: All visible remains of the hyaloid system disappeared early in postnatal life. On early observations the external appearance of the eyes and the fundus was normal and indistinguishable from that of other premature infants who did not subsequently develop retrolental fibroplasia. The earliest detectable abnormality was a slight dilatation of the retinal arteries and veins. The dilatation of both the arteries and the veins gradually increased but was more marked in the veins, which

increased to about three times their normal size. As the vessels increased in size they became very tortuous. This was especially pronounced in the arteries. Often the arteries became so tortuous that they turned backward, running toward the disc for a short distance and then turning sharply in a hairpin curve to run toward the periphery again (fig. 1).

The angiomatous dilatation and tortuosity of the vessels was soon followed by one or

Fig. 5 (Owens and Owens). Advanced stage showing extremely shallow anterior chamber and domelike appearance of the iris (Case 1, right eye).

more small grayish yellow elevations of the retina in the far periphery. The presence of these areas could be suspected by the slightly greater caliber of the vessels extending into the involved quadrant. When first seen these areas were solid looking and elevated from 1 to 3 diopters (fig. 2). There was slight pigmentation around their bases. Over them coursed tortuous retinal vessels, in some cases, ascending the crest of the elevation in a pattern resembling a crow's foot. Soon the margins of the disc became blurred and generalized retinal edema developed. The grayish masses of elevated retina in the periphery increased in height, and other grayish yellow areas appeared scattered throughout the fundus. After a short time, a gray membrane with numerous vessels coursing over it billowed forward in folds at the periphery of the retrolental space. This membrane appeared to be the anterior portion of the large masses of swollen retina. At this stage the fundus could be only hazily seen. Bands of tissue extended from the areas of detached retina into the vitreous. Between these bands a yellowish red fundus reflex was visible (fig. 3).

Finally a complete retrolental membrane was formed by gradual extension and fusion of the peripheral folds of the retina. Broad ciliary processes were seen extending onto the membrane at its periphery and numerous vessels were present on the surface of the membrane. These vessels appeared to radiate from the center as if the membrane had been formed by a regular umbrellalike fusion of retinal folds. Occasionally small hemorrhages occurred into the membrane from these vessels. The diameter of the cornea was usually smaller than normal. The anterior chamber became shallow. Posterior synechias formed and the iris developed a grayish atrophic appearance (fig. 4).

Later some of the eyes showed secondary changes. These consisted of further shallowing of the anterior chamber with extension forward of the iris and lens in a domelike fashion. The tension rose, the cornea became cloudy and the eyes enlarged (fig. 5). In some cases this phase was transient, the anterior chamber later became deeper with clearing of the cornea and return of the tension to normal.

In all cases the disease did not progress to the formation of complete retrolental membranes in both eyes. Occasionally the course of the disease was arrested at some stage in its progress, producing an incomplete picture. In one case the disease progressed in both eyes through the formation of enlarged tortuous vessels and extensive grayish elevations of the retina. It then became arrested. The vessels gradually decreased in

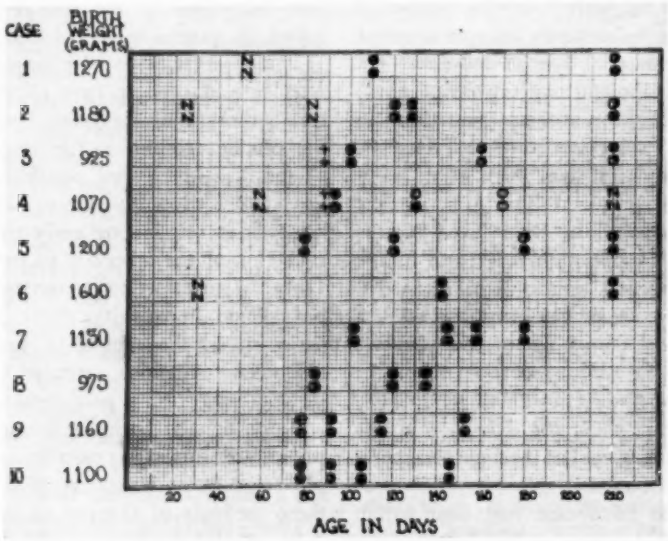
size and the grayish elevations of the retina slowly disappeared. Finally the fundus picture showed no abnormalities except for a slight accumulation of grayish tissue around the margins of the optic nerves.

Occasionally the disease became arrested at the stage in which only a partial membrane had formed behind the lens. In these eyes bands simulating retinal folds extended back through the vitreous to localized areas of retinal detachment. Newly formed vessels were visible in these bands. Between the bands relatively normal-looking areas of fundus were seen. In these eyes, the anterior chamber usually remained of normal depth.

Often a complete retrolental membrane formed but the disease did not progress into the stage of glaucoma. The cornea remained clear. The vessels on the membrane disappeared as the membrane became more opaque. Later in some cases thinner areas appeared in the membrane through which a good red reflex was visible.

Time of onset

One of the purposes of our study was to determine the time of onset of the disease. In our cases the major manifestations of the disease, from the first evidence of fundus abnormality to the appearance of a retrolental membrane occurred between the 2nd and 5th months of postnatal life. Graph 1 shows the time of onset of the various stages in the individual cases. Dilatations of the retinal vessels with the formation of grayish elevations of the retina were observed as early as 80 days or about 2½ months after birth. An incomplete retrolental membrane appeared as early as 85 days postnatally. A complete membrane developed in one case at 105 days or 3½ months after birth. In none of the cases did a retrolental membrane develop after 5½ months of postnatal life.



Graph 1 (Owens and Owens). Time of onset of the various stages in the individual cases. N Normal; + Dilated vessels; ⊕ Dilated vessels and exudate; ◑ Partial membrane; ● Complete membrane.

Comment

We have observed the early stages of retrolental fibroplasia and watched its de-

velopment in premature infants. Angiomatous dilatations of the retinal vessels with retinal edema and the formation of extensive grayish retinal detachments preceded the formation of the retrolental membrane. These observations on the clinical course of retrolental fibroplasia show the inadequacies of the ideas formerly advanced to explain the origin of the lesion. The former explanations were based on observations limited to clinical and pathologic examinations made in the advanced stages of the disease. A lack of knowledge of the early stages in the clinical course of the lesion made interpretation of the available material difficult and uncertain.

It had been thought that retrolental fibroplasia was due to an arrest in growth or an aberration of some structure characteristic of an embryonic or fetal stage of development. Terry proposed the first specific theory along these lines. He believed that the lesion was a fibroplastic overgrowth of the hyaloid artery and tunica vasculosa lentis. However, in none of our cases was there a persistence or reopening of the hyaloid artery or of the tunica vasculosa lentis. In all of our cases the retrolental membrane appeared to result from the extension across the retrolental space of fusing peripheral detachments of swollen grayish retina. The vessels in the membrane had their origin from the retinal vessels and not from vessels associated with the embryonic vascular sheath of the lens.

Reese and Payne advanced the idea that the lesion was a persistence of the primary vitreous with or without hyperplasia. However, in none of our cases was there any evidence of abnormal persistent embryonic structures or defects at the onset of the disease, and in all, the earliest changes observed occurred in the retina and the retinal vessels. At a later date, Krause proposed the theory that the lesion was a prenatal abnormality of the cerebral and retinal neuroectoderm. However in our cases the lesion developed in postnatal life. Early postnatal examinations of the eyes revealed normal fundi, and the earliest detectable abnormalities occurred about two months after birth.

From our observations it appears that retrolental fibroplasia occurring in premature infants is not due to an arrest in growth or aberration of some embryonic or fetal structure. It is not the same as the condition in which fibrous tissue is associated with a persistent hyaloid artery. The early stages of retrolental fibroplasia occurring in premature infants are characterized by angiomatous dilatations of the retinal vessels followed by extensive retinal detachment.

The observations of the clinical course of retrolental fibroplasia have clarified the nature and origin of the lesion. However nothing can be deduced so far as to the cause of the disease. Several possibilities may be considered. Recently there has been increased interest among pediatricians in the reduction of the mortality of premature infants. In an effort to compensate for their physiologic immaturity, these infants are often given diets high in protein, large amounts of vitamins, repeated transfusions of blood and plasma, parenteral amino acids, and occasionally hormone therapy. In some premature nurseries penicillin is given prophylactically on admission. Whether any of these methods of therapy produce a metabolic imbalance which is related to the disease is as yet unknown. Since the early stages of the disease are present before the infant has attained the usual weight for discharge from the premature nursery, such etiologic factors would be active while the infant is under close observation. We are at present attempting to evaluate these factors by a detailed study of the nursery records of the infants who developed retrolental fibroplasia.

It is possible that retrolental fibroplasia may be related to angiomatosis retinae or to Coats's disease. Clinically in its early stages, retrolental fibroplasia resembles angiomatosis retinae and Coats's disease. The

primary change seen in the fundus occurs in the retinal vessels. This is followed by extensive retinal edema and detachment of the retina. Whether there is any pathologic resemblance between these diseases and retrolental fibroplasia is not known because there have been no reported pathologic studies on the early stages of retrolental fibroplasia. It is interesting in this regard that Reese reported the ocular findings in a case of twins born three months prematurely. One twin developed retrolental fibroplasia. The other twin, who died at the age of 3 months, had hemangiomatous tissue on the surface of the retina of both eyes at autopsy. In one of the eyes, the hemangiomatous tissue was associated with a detachment of the retina. It is possible that this pathologic picture may have represented an early stage of retrolental fibroplasia, although clinically it was not recognized as such. It is interesting that Hess, Mohr, and Bartelme[1] found that hemangiomas of the skin appeared to occur more frequently in premature infants than in full-term siblings. In addition, they found that in a group of premature children, the hemangiomas were found among the children with low birth weights (under 2000 gm.).

Whether any of these factors play a role in the etiology of retrolental fibroplasia is unknown. Perhaps the disease is initiated by some factor that is totally unappreciated as yet. However, the knowledge of the early course of the disease serves to redirect thinking about the possible etiologic factors. At the present time studies are being undertaken to investigate some of the hypotheses concerning the etiology of retrolental fibroplasia.

Case reports

Case 1

H. S., a white girl, was born in the Johns Hopkins Hospital on April 14, 1946. Birth weight was 1,270 gm.

June 5, 1946. O.U.: Normal anterior ocular segments except for a few persistent pupillary strands on the temporal side of the right eye. No remains of the posterior portion of the tunica vasculosa lentis or of the hyaloid artery are visible. The media are clear, and the discs, vessels, and peripheral fundus are normal.

August 3, 1946. R.E.: The cornea is clear. The anterior chamber is extremely shallow, being obliterated in the angle. The tension to fingers is normal. The pupillary strands previously noted have disappeared. The pupil is small and dilates poorly. Its margin is serrated with posterior synechias. Behind the clear lens is a grayish membrane with numerous vessels on its surface. The membrane follows the shape of the lens and has a granular appearance.

L.E.: The cornea is clear. The anterior chamber is extremely shallow and obliterated in the angles, the tension is normal to fingers. The pupil dilates well and there are no posterior synechias. Behind the clear lens is a granular grayish membrane with numerous vessels on its surface. The vessels appear to arise from a central core and to run radially, a very large one coursing toward the 5-o'clock position. The membrane varies in thickness and density. It is thinner nasally where a good red reflex can be seen. Large ciliary processes are visible.

August 12, 1946. R.E.: The cornea is clear and measures approximately 9 mm. in diameter. The anterior chamber is extremely shallow but the tension feels normal to fingers. Behind the lens is a dense membrane with vessels running over its surface.

L.E.: The cornea measures approximately 9 mm. in diameter. It is clear. The anterior chamber is extremely shallow. Behind the lens is a fibrous membrane thinner nasally where a red reflex is visible. The tension to fingers is normal.

September 16, 1946. R.E.: The cornea is clear. The anterior chamber is almost completely abolished. There are dilated iris vessels and numerous posterior synechias. Tension is normal to fingers. There has been no change in the retrolental membrane.

L.E.: The cornea is clear. The anterior chamber is deeper than on last examination, and is definitely deeper than that of the right eye. There are no posterior synechias and the pupil dilates well. A good red reflex is still seen through the nasal part of the retrolental membrane. Tension is normal to fingers.

October 1, 1946. There has been profuse tearing from the right eye since the last visit.

R.E.: The cornea is diffusely hazy. The anterior chamber is completely abolished. The iris stroma has a grayish atrophic appearance and a few dilated iris vessels are present on its surface. The pupil is small, irregular, and immobile because of posterior synechias. The iris bulges forward in a domelike fashion. The tension is within the normal range to fingers but feels definitely higher than in the left eye.

L.E.: The cornea is clear. The anterior chamber

is shallow but present everywhere. The pupil dilates well. The lens is clear. The retrolental membrane has increased in density and fine vessels run over its surface. No red reflex can be seen nasally. Large dentate ciliary processes are present.

October 5, 1946. R.E.: The lids are slightly hyperemic. The right globe is slightly larger than the left. The cornea is hazy and the anterior chamber completely abolished. The iris appears gray. The retrolental membrane can just be seen through the small pupil. The tension feels slightly elevated to fingers, and definitely higher than in the left eye.

L.E.: No change since last examination.

October 21, 1946. There has been less tearing of the right eye.

R.E.: The cornea is considerably larger than the left. It measures approximately 12.5 mm. Otherwise there has been no change.

L.E.: The cornea measures 9 mm. Otherwise the picture is the same.

November 2, 1946. O.U.: No change.

November 18, 1946. O.U.: No change.

December 9, 1946. R.E.: There are numerous dilated capillaries along the margin of the upper lid. The cornea has a diffuse haze which is most marked in the inferior temporal portion. The anterior chamber is still completely abolished. The tension, now definitely elevated to fingers, is estimated at 35 to 40 mm. Hg (Schiøtz).

L.E.: No change. The anterior chamber although present everywhere is extremely shallow but the tension feels normal to fingers.

December 23, 1946. R.E.: The cornea is slightly clearer but is still edematous. The tension is still elevated, but seems lower than on last examination.

L.E.: No change.

January 8, 1947. R.E.: The cornea is clearer and the tension is now normal to fingers. A definite anterior chamber has formed in the central and nasal portion of the eye, but a broad anterior synechia is still adherent to the inferior temporal third of the cornea. In the area of the adhesion the iris is grayish, while elsewhere it is brown. The uniformly dense retrolental membrane can be seen through the small secluded pupil.

L.E.: The cornea is clear. The anterior chamber is shallow. The pupil dilates well. The inferior nasal portion of the retrolental membrane has become thinner and a good red reflex can be seen inferiorly and temporally through an oval break in the membrane. The tension is normal to fingers.

January 22, 1947. O.U.: No change.

February 17, 1947. O.U.: No change.

March 3, 1947. R.E.: Cornea measures 12.5 mm. in diameter. It is clear except temporally from the 7- to 11-o'clock positions where there is a broad anterior synechia. Elsewhere the anterior chamber is of moderate depth. The tension is normal to fingers.

L.E.: Cornea measures 10 mm. in diameter. The anterior chamber is slightly shallow. A yellowish red reflex can be seen through the inferior nasal and superior temporal portions of the membrane. Tension is normal to fingers.

March 17, 1947. O.U.: No change.

March 31, 1947. O.U.: No change.

April 14, 1947. O.U.: No change.

August 14, 1947. O.U.: No change.

September 28, 1947. The child shows no blink reflex to a strong light with either eye. Roving nystagmus is present.

R.E.: The cornea measures 13 mm. in diameter. It is clear except for a small cloudy sector below and temporally. The anterior chamber is of moderate depth. A dense retrolental membrane is seen through the small secluded pupil. Tension is low normal to fingers.

L.E.: The cornea measures 12 mm. in diameter, and is clear. Blurred red reflexes can be seen through the thinner areas in the membrane as before. Tension is normal to fingers.

November 24, 1947. O.U.: No change

CASE 2

A. D., a colored boy, was born at home on June 28, 1946, and admitted to the premature nursery of the Harriet Lane Home of the Johns Hopkins Hospital on the same day. The birth weight was 1,180 gm.

July 28, 1946. O.U.: Normal anterior ocular segments except for a few persistent pupillary strands on the temporal portion of the left eye. No remains of the hyaloid artery are visible. Media are clear. Discs, vessels, and peripheral fundus are normal.

September 18, 1946. Pupillary strands are no longer visible in the left eye.

O.U.: Media clear. Discs, vessels, and peripheral fundus are normal.

October 26, 1946. R.E.: The cornea is clear and measures 9.0 mm. in diameter. The iris has a rich brown color. The anterior chamber is of normal depth. The lens is clear. Behind the inferior portion of the lens is a thin opaque membrane. Through the upper half of the lens a yellowish red reflex is visible.

L.E.: The cornea is clear and measures 9.0 mm. in diameter. The anterior chamber is definitely shallower than in the right eye. The iris has a rich brown color. The lens is clear. Behind the lens, a grayish opaque membrane completely encircles the periphery, leaving a relatively clear filmy area about 4 mm. in diameter in the center. The peripheral portion of the membrane is formed by several folds billowing forward. Numerous vessels run over its surface. Broad ciliary processes are present. The central area is avascular and through it a good red reflex is seen.

November 11, 1946. O.U.: No change.

November 18, 1946. R.E.: The cornea measures about 9 mm. in diameter and is clear. The anterior chamber is of normal depth. A heavy veil-like membrane is present in the inferior temporal portion of the vitreous. This veil fans out as it runs for-

ward to the periphery. The veil arises from the surface of the retina below the macula where there are white atrophic scars and clumps of pigment. Because of the veil it is difficult to see any details in the inferior half of the retina. However, in the extreme periphery at the 6-o'clock position retinal vessels can be seen. In the superior portion of the fundus the retina and retinal vessels can be easily seen and appear normal. The disc appears normal. The tension is normal to fingers.

L.E.: The cornea is clear and measures about 9 mm. in diameter. The anterior chamber is shallow. The color of the iris is normal. Encircling the margin of the lens are several white billowing membranous folds covered with large vessels. Behind the center of the lens is a thin filmy avascular grayish membrane.

November 25, 1946. O.U.: No change.

December 2, 1946. R.E.: No retrolental membrane is visible grossly, but with the ophthalmoscope a large vitreous band can be seen extending forward and temporally from the caecocentral area of the retina to a large white mass lying behind the lens in the extreme periphery between the 7- and 8-o'clock positions. A few vessels and several small pigmented areas are present on the surface of this mass. The mass represents detached retina. The nasal border of the disc is clearly seen and is surrounded by heavy pigmentation. The temporal portion of the disc is obscured by the bands which extend forward into the vitreous. The upper portion of the fundus can be clearly seen and appears normal.

L.E.: There has been little change. Behind the clear lens, surrounding it entirely at its circumference, are billowing masses over the surface of which extend large vessels. The thin membrane behind the central portion of the lens is entirely different from the surrounding large billows of denser membrane.

December 23, 1946. R.E.: No change.

L.E.: No change except for slight flattening of the large peripheral billows.

January 8, 1947. R.E.: No change.

L.E.: The large billows in the periphery have become much flatter. They no longer bulge forward and have changed from a yellowish cream to a pale white color. The large vessels on their surface have decreased in size and now exist only as fine threads. The membrane behind the center of the lens has become thinner and a good red reflex is again visible through it. Large ciliary processes are present at the periphery of the heavy membrane.

January 22, 1947. O.U.: No change.

March 17, 1947. O.U.: No change.

March 31, 1947. R.E.: Normal fundus could be seen above with fibrous tissue in the vitreous below as before.

L.E.: No change.

April 14, 1947. O.U.: The corneas are clear and measure about 10 mm. in diameter. The anterior chamber is of normal depth in the right eye but is shallow in the left eye. Tension to fingers is normal in both eyes.

April 28, 1947. O.U.: No change.

May 26, 1947. O.U.: No change.

July 28, 1947. R.E.: The cornea is clear. The anterior chamber is of normal depth. There is a slight vitreous haze with numerous large floating strandlike vitreous opacities. The disc can be seen easily. There are heavy white tissue masses at the superior and inferior poles. Numerous strands extend into the vitreous from the region of the disc. One very heavy band looking like a fold in the retina extends into the lower temporal periphery.

L.E.: Cornea clear. Anterior chamber is slightly shallow. The complete retrolental membrane with its dense irregular periphery and thin flocculent center presents an appearance similar to a doughnut.

September 29, 1947. O.U.: No change.

December 14, 1947. The child definitely sees with the right eye. He will grasp a ruler and pencil held in front of him and reaches outside his play pen to retrieve toys.

R.E.: The cornea is clear and measures about 10 mm. in diameter. There has been no change in the fundus picture.

L.E.: The cornea is clear and measures about 10 mm. in diameter. The anterior chamber is slightly shallow. There is a complete retrolental membrane as before, denser in the periphery with several thin central areas through which a good red reflex is visible.

CASE 3

W. S., a colored boy, was born in the Johns Hopkins Hospital on November 1, 1946. Birth weight was 925 gm.

January 27, 1947. O.U.: Normal anterior ocular segments except for a few small persistent pupillary vessels. The media are clear. The discs are normal in color and outline. The arteries are normal but the veins appear slightly dilated and tortuous. The macula and peripheral fundi are normal.

February 8, 1947. R.E.: The cornea is clear. The anterior chamber is of normal depth. The iris is normal and the small pupillary strands have disappeared. The media are clear. The temporal border of the disc is blurred. The veins are more dilated and tortuous than before and there is slight generalized retinal edema. In the far peripheral fundus below at the 5- and 7-o'clock positions are grayish elevations of the retina about 1 or 2 diopters in height. Large tortuous vessels run into these areas. No retinal hemorrhages are present.

L.E.: The cornea is clear. The anterior chamber is of normal depth. The iris is normal and the pupillary strands are no longer present. The media are clear. The entire border of the disc is blurred. The edema is greatest temporally where it extends from the disc into the retina for a short distance. The veins are greatly dilated and tortuous. Inferiorly and temporally from the 3- to 6-o'clock positions there is a solid-looking grayish elevation of

the retina about 3 diopters in height. Large retinal vessels extend into this area and at its border are several small hemorrhages. Two small round hemorrhages lie between the disc and this elevated area.

Impression: Probably angiomatosis retinae, each eye.

February 14, 1947. R.E.: There has been an extension of the retinal detachment in the periphery of the fundus; both the superior temporal and the superior nasal areas are now involved.

L.E.: There has been similar extension of the edema in this eye. A large mass of edematous detached retina is now present superiorly and temporally. Both the retinal veins and arteries are exceedingly dilated and tortuous. The infant was seen by Dr. F. B. Walsh and Dr. J. S. Guyton who concurred in the recommendation of roentgen therapy.

February 18, 1947. Roentgen therapy started using 200 kilovolts, 20 milliamperes, 50 mm. skin target distance, 42 mm. portal, and 0.25 mm. copper and 1 mm. aluminum filters. Roentgen therapy to left eye, 400 roentgen units.

February 19, 1947. L.E.: Roentgen therapy—250r.

February 20, 1947. L.E.: Roentgen therapy—250r.

February 23, 1947. R.E.: Media are clear. The fundus picture is unchanged since last examination, except for increased retinal edema in the region of the disc. There are no areas of retinal hemorrhage.

L.E.: There is a faint vitreous haze. There is marked edema of the disc and peripapillary areas as before. There is no change in the character of the retinal vessels or in the massive peripheral edematous retinal detachments.

March 1, 1947 O.U.: No essential change in the fundus picture.

March 7, 1947. L.E.: Roentgen therapy—250r.

March 8, 1947. R.E.: The media are clear. The outline of the disc is now barely visible in the edema of the surrounding retina. The retinal vessels are greatly dilated and tortuous as before. There is a nearly complete peripheral detachment of the retina extending from the 2- to 10-o'clock positions, elevated about 6 diopters. The detachment has an irregular yellowish gray color and is solid looking. No hemorrhages are present.

L.E.: There is a large detachment of the retina temporally extending from the disc to the periphery of the fundus from the 3- to 7-o'clock positions. This has a solid appearance and is elevated about 4 diopters. There are a few small hemorrhages and several small areas of telangiectasis at the periphery of the area of detached retina. Large tortuous vessels course over the remainder of the fundus but elsewhere the retina is not detached.

March 12, 1947. R.E.: Roentgen therapy—400r.

March 13, 1947. R.E.: Roentgen therapy—250r.

March 14, 1947. R.E.: Roentgen therapy—250r.

March 15, 1947. R.E.: Media are clear. The outlines of the disc are obscured by generalized edema. There is a complete detachment of the retina which is greatest inferiorly where the retina is gray and elevated about 5 diopters. Elsewhere the retina has a grayish red color. No retinal hemorrhages are present.

L.E.: The media are clear. The disc can be seen clearly, and its nasal border is sharply outlined. There is edema of the temporal border of the disc, extending out into the periphery of the retina from the 4- to 6-o'clock positions. Here the retina has a solid gray appearance and is elevated about 3 diopters. Elsewhere the retina is not detached and has a good red color. There has been no change in the caliber or character of the dilated and tortuous retinal vessels.

March 29, 1947. O.U.: No change.

April 10, 1947. R.E.: The cornea is clear and measures 9 mm. in diameter. The anterior chamber is slightly shallow. The iris appears normal and there are no posterior synechias. In the temporal periphery behind the lens a grayish membrane extends from the 6- to 11-o'clock positions. Numerous large vessels run over the surface of the membrane, and ciliary processes are visible at its periphery. A good red reflex is present centrally and nasally but no fundus details are visible.

L.E.: The cornea is clear and measures 9 mm. in diameter. The anterior chamber is of normal depth. A grayish membrane extends temporally behind the periphery of the lens from the 3- to the 6-o'clock positions. A heavy vitreous band extends back to the region of the disc from the inferior portion of this retrolental membrane. Numerous fine strands extend into the vitreous from the upper portion of the membrane. The disc is obscured by a mass of exudate. Nasally there is a diffuse yellowish infiltration of the retina.

April 22, 1947. O.U.: No change.

June 30, 1947. R.E.: The cornea is clear and measures 9 mm. in diameter. The anterior chamber is very shallow. The pupil dilates well. A vascularized opaque membrane now completely covers the retrolental space. Typical dentate ciliary processes are present. The membrane is thicker in the midperiphery than in the center of the retrolental space, but no red reflex is visible anywhere. The tension is normal to fingers.

L.E.: The cornea is clear and measures 9 mm. in diameter. The anterior chamber is shallow, but not as shallow as that in the right eye. In the temporal half of the retrolental space from the 2- to the 6-o'clock positions extends an opaque membrane with a sheath of vessels on its surface. A large mass can be seen extending backward from the retrolental membrane toward the posterior pole. This white, vascularized mass appears to arise from the retina near the disc. At the site of its origin there is heavy pigmentation of the retina. Another mass is seen in the anterior vitreous from the 6- to the 9-o'clock positions. Typical dentate ciliary processes are seen temporally. There are clearer areas behind the processes through which a dull red reflex is visible. Su-

periorly and nasally a good red reflex is seen and a few fundus vessels can be distingushed. The tension is normal to fingers.

August 4, 1947. R.E.: The cornea is clear. The anterior chamber is shallow. Behind the lens is a dense opaque membrane with numerous vessels on its surface. Typical dentate ciliary processes are drawn into the membrane everywhere in the periphery. The tension is normal to fingers.

L.E.: The cornea is clear. The anterior chamber is shallow, but still deeper than that in the right eye. There is a heavy retrolental membrane covered with vessels temporally from the 1- to the 6-o'clock positions. From the membrane a mass extends back through the vitreous to a heavily pigmented scar in the retina. Above and nasally the fundus can be clearly seen, and appears to be normal except for moderate pigment stipling.

October 27, 1947. O.U.: No change.

December 8, 1947. The child has roving nystagmus. No blink reflex can be elicited in the right eye. A blink reflex is elicited in the left eye with strong light only.

R.E.: The cornea is clear and measures 10 mm. in diameter. The anterior chamber is only slightly shallow. The pupil dilates well. There is a complete retrolental membrane. The vessels have disappeared from its surface. The membrane is not uniformly dense but no red reflex can be seen through it anywhere. The tension is normal to fingers.

L.E.: The cornea is clear and measures 10 mm. in diameter. The anterior chamber is of normal depth. The pupil dilates well. There is a retrolental membrane temporally from the 1- to the 7-o'clock positions. This membrane is the anterior portion of a mass extending posteriorly to the region of the disc which cannot be identified. The mass arises from a pigmented area of the retina just nasal to the disc. The upper nasal fundus can be clearly seen and shows diffuse pigment mottling. No retinal vessels are visible in this clear area. Tension is normal to fingers.

CASE 4

M.D., a white girl, was born in the Johns Hopkins Hospital on January 2, 1947. Birth weight was 1070 gm.

March 1, 1947. O.U.: The anterior ocular segments are normal. The media are clear. Disc, vessels, macula, and peripheral fundus are normal.

March 31, 1947. O.U.: The corneas are clear. The anterior chambers are of normal depth. The media are clear. The discs are normal in color and outline. There is marked dilatation and increased tortuosity of both veins and arteries, especially below and temporally in each eye. The veins are about 2½ times and the arteries about 2 times their normal caliber. No localized aneurysmal dilatations were seen. The peripheral fundi are normal. There are no hemorrhages or exudates.

April 3, 1947. R.E.: Media are clear. There is marked tortuosity of the vessels as before. In the far temporal periphery at the 9-o'clock position are isolated solid-looking areas of retinal detachment, elevated about 2 to 3 diopters. These are irregular in size and present a cobblestone appearance. There is slight pigmentation around their bases. Dilated vessels run over these areas so that the elevations resemble pebbles held in a crow's foot.

L.E.: Media are clear. There are similar irregular solid-looking areas of retinal elevation in the temporal periphery at the 5- to 6-o'clock positions. Their appearance and relation to the vessels is the same as in the right eye.

April 7, 1947. O.U.: No change.

April 10, 1947. R.E.: Media are clear. There is no change in the fundus picture. The vessels are huge and tortuous as before. There are no hemorrhages.

L.E.: The media are clear. There is slight graying of the retina around the superior temporal artery just as it leaves the disc. Below and temporally the neuroretinal border is blurred. In the temporal periphery from the 4- to 6-o'clock positions is a diffuse yellowish retinal elevation about 3 diopters in height. No hemorrhages are present.

April 15, 1947. R.E.: The media are clear. There is marked tortuosity of the vessels. The margins of the disc are still sharply outlined. The areas of retinal elevation in the temporal periphery have now become larger and confluent, extending from the 7- to 11-o'clock positions, where the retina is elevated about 3 diopters. The elevation has a murky gray appearance and the vessels coursing over it are partly obscured in the edema.

L.E.: There is a slight diffuse vitreous haze. The disc margins are blurred especially below and temporally. The entire retina appears slightly edematous. There are two large areas of retinal detachment, one above and temporally from the 1- to 3-o'clock positions where the retina shows a grayish elevation of 8 diopters; the other below and temporally where there is a similar elevation of 3 diopters. No hemorrhages are present.

April 23, 1947. O.U.: No change.

April 30, 1947. R.E.: Media are clear. The lower temporal margin of the disc is blurred. The veins are less dilated than before and there is no measurable elevation of the retina in the periphery.

L.E.: The media are clear. Both the upper and lower poles of the disc are blurred. The veins are still dilated. The retina shows a grayish elevation of about 3 diopters in the lower temporal periphery.

May 6, 1947. Both eyes are considerably improved.

R.E.: The media are clear. The lower pole of the disc is blurred. The veins are slightly dilated but the arteries are nearly normal in appearance. No areas of retinal detachment are seen.

L.E.: The media are clear. The veins are still dilated, being about 1½ times their normal size, although their caliber is not so great as formerly. The major arteries still are tortuous and the lower temporal artery is intermittently buried in areas of retinal edema. No areas of retinal detachment are seen.

May 15, 1947. R.E.: The media are clear. The

disc is of normal outline and color. In the periphery, however, at the 2- and 8-o'clock positions are small localized grayish yellow retinal areas elevated about 6 diopters.

L.E.: The media are clear. The temporal margin of the disc is elevated about 1½ diopters. The caliber of the veins is still about 1½ times their normal size. In the temporal periphery between the 1- and 3-o'clock positions is a localized grayish area in the retina elevated about 6 diopters. The superior temporal vein bisects this area of elevation and there are two small grayish flecks along the course of this vessel.

May 27, 1947. R.E.: There is slight vitreous haze. The disc margin is slightly blurred. The retinal veins are still somewhat dilated but they have decreased markedly in size from their former extremely dilated state. They are still very tortuous. The entire periphery of the retina is grayish, with a solid-looking area of grayish white elevation of about 10 diopters. Temporally the grayish elevation nearly extends forward to the margin of the lens. No ciliary processes are present.

L.E.: The media are clear. The disc is of normal color and outline. In the far temporal periphery the retina is gray and elevated about 10 diopters. No ciliary processes are present.

June 6, 1947. O.U.: No change.

June 7, 1947. O.U.: No change.

June 19, 1947. O.U.: There is slight blurring of the upper pole of each disc. The arteries and veins have returned to their normal size but are still excessively tortuous. In the periphery of the fundus, extending around the entire circumference in the right eye and only around the temporal side in the left eye, is a grayish white mass, measuring about 2 diopters in height.

June 30, 1947. O.U.: No change.

August 4, 1947. O.U.: The media are clear. The upper and lower poles of the disc are slightly blurred. The vessels are of normal caliber but are still somewhat tortuous. In the extreme periphery the retinas are of a grayish color but are no longer elevated.

October 6, 1947. O.U.: No change.

December 15, 1947. O.U.: The cornea of each eye is clear and measures about 11 mm. in diameter. The media are clear. The fundi are seen with a −8 lens. The discs are of normal color and outline with a small amount of gray tissue at the upper and lower poles. The vessels are of normal caliber. The maculas and peripheral fundi are normal. The child apparently sees well and will reach for and grasp small objects with either eye occluded.

CASE 5

R. L., a colored boy, was born at home on May 12, 1947, and admitted to the premature nursery of the Harriet Lane Home of the Johns Hopkins Hospital. His birth weight was 1,200 gm.

June 30, 1947. O.U.: The anterior ocular segments are normal.

R.E.: The vitreous has a fine diffuse haze. The borders of the disc are blurred and gray. The veins are greatly enlarged and the arteries extremely tortuous. In the entire periphery of the retina are elevated grayish areas into which the retinal vessels run. A large heavy band runs from one of these grayish elevations through the vitreous toward the periphery of the lens. The intraocular pressure feels normal to fingers.

L.E.: Shows essentially the same picture. The vitreous is diffusely hazy. The disc margins are blurred. The veins are greatly dilated and the arteries extremely tortuous. In the lower periphery of the retina are two large grayish elevated areas into which the vessels run.

July 7, 1947. R.E.: The transverse diameter of the cornea is 10.5 mm. The anterior chamber is deep. The iris structure is normal. The diffuse haze of the vitreous has increased. The disc can be seen with a −15 lens. Its borders are blurred, and fluffy white areas cover the upper and lower poles. The retinal veins have increased to about 2 or 3 times their normal size. The arteries have increased in tortuosity. Often the arteries turn backward to run again toward the disc for a short distance and then turn sharply with a hairpin curve to run toward the periphery again. The entire retina has developed a grayish yellow color. Everywhere in the periphery are extensive grayish elevations. Numerous fine vitreous bands are present. An extremely large band arising posteriorly in the upper nasal quadrant extends anteriorly to the lower temporal periphery of the vitreous.

L.E.: The transverse diameter of the cornea is 10 mm. The anterior chamber is deep. The iris structure is normal. The diffuse haze of the vitreous has increased markedly. The area of the disc can be distinguished, but a grayish cloud completely obscures the disc itself. Although the vessels can no longer be seen clearly, their hazy forms can be indistinctly seen as lighter and darker red streaks running from the obscured area of the disc to the periphery. The entire fundus is grayish yellow in color. Everywhere in the extreme periphery arise large masses of grayish white retina. It is difficult to get these elevations into sharp focus. There are numerous fine vitreous strands. In the lower nasal periphery these are very thick and opaque, appearing as numerous irregular grayish strands separated by streaked areas of brilliant red color.

July 14, 1947. R.E.: No change. Tension feels normal to fingers.

L.E.: The process has extended. The grayish elevated masses in the periphery have increased in size. The one in the lower nasal quadrant has pushed so far forward that it is now visible grossly behind the periphery of the lens. It has a few strands of hemorrhage on its surface. A few shadowy forms of the superior fundus can be hazily seen with a −15 lens.

July 28, 1947. R.E.: The anterior ocular segment is normal. The vitreous has become much hazier

and now contains numerous large vitreous strands. Some of these are opaque and others, although having an increased optical density, are still transparent. The generalized haze of the vitreous has become so intense that the fundus can no longer be seen.

L.E.: There is no injection. The anterior chamber is deep and the pupil dilates well. The large retrolental grayish mass below and nasally has increased in size. The vitreous has become even more cloudy but a few hazy fundus details can be barely seen.

August 11, 1947. R.E.: The anterior chamber is deep. The pupil dilates well and there are no posterior synechias. Behind the lens from the 3- to 6-o'clock positions, a filmy membrane billows forward in folds, resembling a retinal detachment. The consistency of the membrane appears denser than that of a simple detachment, but not as dense as the retrolental membrane in the left eye. On its temporal side, the membrane extends back into the vitreous toward the posterior pole of the eye. At about the 4-o'clock position a large tuft of dilated vessels arises from the axial portion and extends over the edge of the membrane. In the extreme periphery, a few thin ciliary processes are present in front of the membrane. There are no hemorrhages on the membrane. Hazy glimpses of the fundus with a −20 lens show scattered shadowy areas of white atrophic scarring with occasional pigmentations. The tension is easy normal to fingers.

L.E.: The cornea is clear, and the anterior chamber is deep. The pupil dilates well. The heavy retrolental membrane extending from the 5- to 11-o'clock positions appears denser and two large hemorrhages are present on its surface. Toward its axial portion, the membrane extends backward into the vitreous toward the posterior pole. In the far periphery thick, coarse ciliary processes are present in front of the membrane. The vitreous has become so cloudy that only a good red reflex can be obtained.

September 15, 1947. O.U.: No change.

October 6, 1947. There is no blink reflex in either eye.

R.E.: The transverse diameter of the cornea measures 11 mm. The anterior chamber is deep and the tension feels normal to fingers. The pupil dilates well. The retrolental membrane has increased in size, now covering the nasal half of the lens. The ciliary processes at the periphery have become larger and more prominent. The fundus can no longer be seen temporally although a good red reflex can be seen.

L.E.: The transverse diameter of the cornea measures 11.0 mm. The anterior chamber is deep and there are no posterior synechias. The retrolental membrane nasally has become denser and the vessels have disappeared from its surface. In addition a less dense membrane has formed over the temporal side of the retrolental space, leaving only a small area above from the 11- to 12-o'clock positions where a good red reflex can be seen. The membrane on the temporal side forms a large billow which meets the nasal membrane in the axial portion of the eye behind the lens. Large ciliary processes extend in front of the membrane on all sides.

November 10, 1947. R.E.: No change.

L.E.: The membrane has extended. The temporal portion has become denser and has gradually closed in superiorly to meet the nasal portion of the membrane. No red reflex can now be obtained.

December 1, 1947. R.E.: There is no hyperemia of the anterior ocular vessels. The transverse diameter of cornea is 11.0 mm. The anterior chamber is deep and the tension feels normal to fingers. The pupil dilates well. There has been no change in the dense membrane on the nasal side of the retrolental space. On the temporal side a good red reflex can be obtained, but the vitreous contains numerous flocculent masses. A small cluster of round bodies resembling Elschnig bodies is present in the temporal portion of the lens.

L.E.: Transverse diameter of the cornea is 11.0 mm. The anterior chamber has become shallower and the iris slightly dome shaped. The membrane covering the posterior surface of the lens shows no changes.

CASE 6

S. C., a white boy, was born in the Johns Hopkins Hospital on April 1, 1947. His birth weight was 1,600 gm.

April 30, 1947. O.U.: Normal anterior ocular segments. The media are clear. The discs, vessels, maculas, and peripheral fundi are normal.

August 20, 1947. Seen in Wilmer Dispensary by Dr. Naquin.

O.U.: The corneas are clear. The anterior chambers are shallow. There are complete membranes behind the lenses. The tension is normal to fingers.

November 5, 1947. R.E.: The cornea is clear and measures 10 mm. in diameter. The anterior chamber is shallow. There is doming of the iris which has an atrophic grayish appearance near the limbus. There are numerous posterior synechias and the pupil dilates poorly. There is a complete opaque retrolental membrane on which no vessels are visible. The tension is normal to fingers.

L.E.: The cornea is clear and measures 10 mm. in diameter. The anterior chamber is shallow. The iris appears normal in color. The pupil dilates well and there are no posterior synechias. There is a complete retrolental membrane which has a flocculent appearance. A few small vessels are present on the membrane below. Nasally in the far periphery a dull yellowish red reflex is visible. Large ciliary processes are present. The tension is normal to fingers.

December 1, 1947. No blink reflex can be elicited to a strong light in either eye.

R.E.: The cornea is clear. The anterior chamber is very shallow. The iris pushes forward like a dome and there is an almost complete ring of pos-

terior synechias. The retrolental membrane is dense, fibrotic, and avascular. The tension is normal to fingers.

L.E.: The cornea is clear. The anterior chamber is shallow, but deeper than in the right eye and no posterior synechias are present. A complete flocculent, grayish white, avascular membrane lies behind the lens. A diffuse yellowish red reflex is visible through the nasal portion of the membrane. Short stubby ciliary processes are visible. The tension is normal to fingers.

CASE 7

O. B., a white boy, was born in the Johns Hopkins Hospital on June 12, 1947. His birth weight was 1,130 gm.

September 22, 1947. R.E.: The cornea is clear and measures 10 mm. in diameter. The anterior chamber is of normal depth. The iris structure is normal. There are no posterior synechias. Behind the clear lens, either in contact with its posterior surface or just behind it, is a thin, membranous fold covered with a fine network of vessels. This membrane extends from the nasal side about two thirds of the way across the retrolental space. A heavy band runs from this vascular membrane through the vitreous in an inferior temporal direction to the periphery of the retina. Several finer vitreous bands leave the membrane and extend below and nasally. A yellowish red reflex is present everywhere, and superiorly and inferiorly a few retinal vessels can be hazily seen. The surface of the retina appears yellowish red in these areas. No ciliary processes are present.

L.E.: The cornea is clear and measures 10 mm. in diameter. The anterior chamber is of normal depth. The iris structure is normal and there are no posterior synechias. Inferiorly and temporally from the 3- to 7-o'clock positions the retina is elevated about 3 diopters. In this area it is scarred and edematous, some portions of its being white, others yellow. Coursing over the surface of the retinal elevation are large irregular vessels. In the midperiphery of the elevated retina is a group of irregularly dilated tortuous vessels, some having small aneurysmal dilatations. The fundus above is hazily seen. Here it has a reddish yellow color with areas of scarring. Irregular dilated vessels run over its surface.

October 6, 1947. R.E.: The cornea is clear. The anterior chamber is of normal depth. The retrolental membrane has a gray color and dense appearance. The vessels on its surface have become less prominent. The heavy vitreous band extending temporally runs to a grayish white elevation of the retina at the periphery at the 7-o'clock position. This retinal elevation projects into the center of the vitreous. A good red reflex is visible above and below it, but no fundus details can be seen. No ciliary processes are present.

L.E.: The cornea is clear. The anterior chamber is of normal depth. The fundus can be seen indistinctly. The lower temporal portion of the retina appears detached and there are several large grayish clouds in the vitreous below. The entire retina appears edematous and yellowish red in color.

October 20, 1947. R.E.: The retrolental membrane has increased in size, having fused with the detachment of the retina which projected forward into the vitreous in the inferior temporal quadrant. The membrane now extends across the retrolental space except in the superior temporal quadrant where a good red reflex is still visible. The membrane is grayish white in color and has numerous vessels on its surface.

L.E.: There are now extensive grayish white masses billowing forward into the vitreous behind the lens, coming in from the temporal side. These masses are irregular in shape and have numerous dilated vessels on their surface. There are several small hemorrhages on the surface of the masses. A good red reflex is still visible nasally.

November 3, 1947. R.E.: There is slight pericorneal injection and a fine diffuse corneal haze. The cornea measures 10 mm. in diameter. The anterior chamber is of normal depth. The pupil dilates eccentrically with good dilatation nasally and only slight dilatation temporally. The membrane now extends completely across the retrolental space. There are numerous large vessels on its surface. Tension is an easy normal to fingers.

L.E.: The cornea is clear and measures 10 mm. in diameter. The anterior chamber is of normal depth. A dense, gray, fibrotic membrane has formed in the temporal two thirds of the retrolental space. Large vessels arise from the axial border of the membrane and course over its surface toward the periphery. A second band-shaped gray mass arises posteriorly and extends through the vitreous to the periphery at the 8-o'clock position. There are numerous dilated vessels on this band. Above and below the band a dull red reflex is visible nasally. Short ciliary processes are present in front of the dense temporal portion of the membrane. Tension is normal to fingers.

November 10, 1947. O.U.: No change.

November 17, 1947. R.E.: The lids are slightly hyperemic. There is slight pericorneal injection. There is a faint corneal haze. The cornea measures 11 mm. in diameter. The anterior chamber is of normal depth and contains a small hyphemia. The pupil dilates eccentrically as before with good dilatation nasally. There is a complete retrolental membrane. The tension feels slightly elevated to fingers.

L.E.: The cornea is clear and measures 10 mm. in diameter. The anterior chamber is of normal depth. The temporal membrane and the nasal gray mass have met in the axial portion of the eye to form a complete retrolental membrane. As the billowing masses have fused, they have gradually encroached on the areas where a red reflex was previously present, finally to obliterate them. The tension is normal to fingers.

November 26, 1947. R.E.: There is no pericorneal injection. The cornea is slightly hazy. The anterior chamber is of normal depth. The pupil is still widely but eccentrically dilated as before. Only a trace of hyphemia remains. The retrolental membrane appears to be displaced backward. The tension is still slightly elevated to fingers.

L.E.: No change.

December 8, 1947. R.E.: The cornea is slightly edematous and measures 12 mm. in diameter. The anterior chamber is deep. The pupil is widely and eccentrically dilated as before. There is atrophy of the iris temporally from the 8- to 10-o'clock positions. There is no hyphemia. There are numerous vessels on the nasal side of the retrolental membrane. The tension is still slightly elevated to fingers.

L.E.: The cornea is clear and measures 10 mm. in diameter. The anterior chamber is very shallow and the iris comes forward like a dome. There are several posterior synechias. Numerous vessels are present on the membrane which completely covers the retrolental space. Typical ciliary processes are present in front of the membrane everywhere in the periphery. The tension is slightly elevated to fingers.

CASE 8

D. H., a white boy, was born in the Johns Hopkins Hospital on July 9, 1947. Birth weight was 975 gm.

October 1, 1947. O.U.: The corneas are clear. The anterior chambers are of normal depth. The iris structure is normal. The tension feels normal to fingers.

R.E.: The vitreous is diffusely hazy and only a blurred red reflex can be seen. In the anterior vitreous extending from the 3- to 6-o'clock positions is a grayish mass. No definite vessels could be seen on its surface.

L.E.: The vitreous is cloudy and only an indistinct yellowish red fundus reflex can be seen. In the nasal half of the anterior vitreous extending from the 6- to 12-o'clock positions is an extensive grayish mass. It seems to be formed by the fusion of two billows. The superior billow appears dense and fibrous and has no vessels on its surface. The inferior billow is less dense and has numerous large vessels coursing over its surface.

October 8, 1947. R.E.: The transverse diameter of the cornea is 9 mm. With a —8 lens the temporal portion of the fundus can be hazily seen but no vessels can be accurately made out. On the nasal side, the retina chages from a reddish color posteriorly to a reddish yellow color which ends in an extensive grayish mass in the periphery. The mass arises from the peripheral portion of the retina and reaches the nasal portion of the posterior surface of the lens. Large coarse ciliary processes resembling blunt teeth of a comb extend in front of this elevated mass. A thin membrane with numerous vessels extends from the mass two thirds of the way across the retrolental space.

L.E.: The transverse diameter of the cornea is 9 mm. The pupil dilates well. Around the entire periphery of the lens at its posterior surface is a heavy opaque, gray membrane. Coarse ciliary processes are present in front of the membrane nasally. The membrane covers about one quarter of the posterior surface of the lens on each side. In the central one half there is a thin filmy membrane with irregular edges. Large vessels run over its surface. A red fundus reflex can be seen on the temporal side.

October 23, 1947. There has been marked progression in each eye.

R.E.: The cornea is clear. The anterior chamber has become slightly shallow. The mass in the nasal portion of the vitreous has increased in size. The retrolental membrane has become denser. A good red fundus reflex can be obtained temporally.

L.E.: The cornea is clear. The anterior chamber is shallow. The coarse peripheral membrane has increased in size and the central portion has become much more dense and opaque. Large vessels are still present on the membrane.

November 5, 1947. R.E.: The transverse diameter of cornea measures 9.5 mm. The cornea is clear. Anterior chamber has become extremely shallow, but the tension feels normal to fingers. The iris bulges forward in a domelike fashion. There are a few dilated vessels on its surface. The retrolental membrane has become complete, covering the entire posterior surface of the lens. There are a few small dilated vessels on the grayish, irregular surface of the membrane.

L.E.: The transverse diameter of the cornea measures 9.5 mm. The anterior chamber is shallow but the tension feels normal to fingers. Posterior synechias have formed at the 12- and 5-o'clock positions. The membrane behind the lens has become thicked and now completely covers the posterior surface of the lens.

November 21, 1947. The picture is essentially the same in both eyes. There is a fine horizontal pendular nystagmus. The child shows no blink reflex to stimulation with bright light.

O.U.: The corneas are clear. The anterior chambers are very shallow but the tension feels normal. Posterior snyechias prevent complete dilatation of the pupils. Behind the entire posterior surface of each lens is a grayish membrane with a few vessels running over its surface. Thick ciliary processes extend in front of the membrane at the periphery.

CASE 9

C. D., a white boy, was born at home on July 22, 1947, and admitted to the premature nursery of the Harriet Lane Home of the Johns Hopkins Hospital on the same day. His birth weight was 1,160 gm.

October 8, 1947. R.E.: The cornea is clear and measures 9 mm. in diameter. The anterior chamber

is of normal depth. The iris is normal. The lens is clear. There is a slight vitreous haze. The retinal vessels are dilated and tortuous as they emerge from the disc, the outlines of which are blurred. Everywhere the retina is gray and irregularly covered with large yellowish areas. In the far temporal periphery from the 8- to 11-o'clock positions the retina is elevated 5 diopters. Huge retinal vessels ascend the crest of this solid-looking elevation in a pattern resembling a crow's foot. There appears to be beginning clouding of the vitreous from the crest of this elevation. There is no retrolental membrane.

L.E.: The cornea is clear and measures 9 mm. in diameter. The anterior chamber is of normal depth. The iris is normal. The lens is clear. There is a moderate vitreous haze. The outlines of the disc are blurred. The retinal vessels are moderately dilated and tortuous. The retina is grayish with large yellowish areas scattered everywhere. The retina is not elevated in the periphery. There is no retrolental membrane.

October 23, 1947. The condition has progressed markedly. In the lower nasal and lower temporal periphery there are membranes behind the lens. Large vessels course over them and it is apparent that the membranes are the anterior portions of large masses that arise from the retina. The fundus can be hazily seen, showing huge dilated tortuous veins and arteries.

L.E.: The retinal vessels are greatly dilated and tortuous. There are extensive yellowish gray areas scattered throughout the retina. No retrolental membrane is present.

October 27, 1947. O.U.: No change.

November 10, 1947. R.E.: The cornea is clear. The anterior chamber is of normal depth. The outlines of the disc are blurred. In the far periphery from the 5- to 11-o'clock positions is a solid-looking detachment of the retina, elevated about 12 diopters. The anterior portion of this detachment billows forward to form a retrolental membrane. Numerous large vessels course over this membrane. Short ciliary processes are visible in this area. There is a similar elevation around the entire periphery of the retina, but elsewhere the elevation does not billow forward into the retrolental space. There is marked generalized edema of the entire retina, which is elevated from 2 to 5 diopters in height, the elevation gradually ascending from the disc to the periphery. One large band with vessels on its surface runs from the disc temporally to the base of the retrolental membrane. This band resembles a retinal fold, although it has formed since the previous examination. Over the upper portion of the retina course numerous moderate-sized retinal vessels, in a pattern somewhat resembling that of the choridal vessels.

L.E.: There is a slight vitreous haze. The nasal border of the disc is blurred and merges with a large swollen yellow area in the surrounding retina. Temporally the retina is elevated about 6 diopters. There is a similar although less extensive graying nasally where the retina is elevated from 3 to 4 diopters. The veins and arteries are dilated to about twice their normal size and are markedly tortuous. There is no retrolental membrane.

November 21, 1947. R.E.: There has been slight progression of the lesion in the past week. The retrolental membrane extends from the 5- to 11-o'clock positions as before, but appears to have extended slightly farther nasally over the retrolental space. The rest of the fundus is unchanged except for increased generalized retinal graying, the pattern of the retinal vessels being nearly obscured in the yellowish red background.

L.E.: Slight vitreous haze. As in the right eye there has been increased generalized retinal edema and graying, the nasal portion of the fundus now being nearly as involved as the temporal side. The retinal arteries and veins are still dilated to about twice their normal size. No retrolental membrane is present.

December 8, 1947. R.E.: The cornea is clear and measures 10 mm. in diameter. The anterior chamber is of normal depth. The iris is normal. There are no posterior synechias. The retrolental membrane has extended a little farther nasally to the 4-o'clock position, but does not extend forward any farther across the retrolental space. There are still large vessels on its surface. Broad ciliary processes are visible temporally. Posteriorly a yellowish red reflex is visible, but no fundus details can be seen.

L.E.: The cornea is clear and measures 10 mm. in diameter. The anterior chamber is of normal depth. The iris is normal. The nasal border of the disc is sharply outlined as before, but the temporal border is still blurred. The retinal vessels are still dilated but nearly buried in the increased generalized retinal exudation. The area of the disc is seen with a −5 lens, while the lower temporal periphery where the retina is most elevated is seen with a +5 lens. No retrolental membrane is present.

December 22, 1947. O.U.: No change.

Case 10

S. D., a white girl, (twin sister of C. D., Case 8) was born at home on July 22, 1947, and admitted to the premature nursery of the Johns Hopkins Hospital on the same day. Her birth weight was 1,100 gm.

October 8, 1947. R.E.: The cornea is clear and measures 9 mm. in diameter. The anterior chamber is of normal depth. The iris is normal. The lens is clear. There is a moderate vitreous haze. The fundus is seen with a −8 lens. The region of the disc can be easily identified, but the disc itself is obscured by a filmy mass of exudate extending forward for a short distance into the vitreous. The retinal vessels are extremely dilated and tortuous. The entire retina is edematous and irregularly infiltrated with large yellowish gray areas of exudation. No hemorrhages are present. There is no retrolental membrane.

L.E.: The cornea is clear and measures 9 mm. in diameter. The anterior chamber is of normal depth. The iris is normal. There is considerable vitreous haze. The fundus is seen with a —8 lens. The disc is obscured by a large grayish mass which extends forward into the posterior portion of the vitreous. A linear hemorrhage is present on the surface of this mass. On each side of the gray mass at a short distance from the disc the retinal vessels can be seen. They are of huge caliber and tortuous as in the right eye. There is no retrolental membrane.

October 23, 1947. R.E.: The cornea is clear. The anterior chamber is of normal depth. There are no posterior synechias and the pupil dilates well. The fundus cannot be seen. Behind the clear lens is a dense grayish white membrane covered with dilated vessels. The membrane extends completely across the retrolental space. There are several small hemorrhages on its surface. The tension is normal to fingers.

L.E.: The cornea is clear. The anterior chamber is of normal depth. There are no posterior synechias, and the pupil dilates well. As in the right eye there is a dense grayish white membrane extending completely across the retrolental space. There is one small hemorrhage on its surface. Tension to fingers is normal.

November 5, 1947. R.E.: The cornea is clear and measures 9.5 mm. in diameter. The anterior chamber is shallow. There are no posterior synechias and the pupil dilates well. There is a complete retrolental membrane on the surface of which are many small vessels. No hemorrhages are present. Numerous short ciliary processes are seen. The tension is normal to fingers.

L.E.: The cornea is clear and measures 9.5 mm. in diameter. The anterior chamber is shallow. The pupil dilates poorly because of the posterior synechias at the 6- and 9-o'clock positions. There is a complete retrolental membrane with numerous small vessels, but no hemorrhages on its surface. Tension is normal to fingers.

December 1, 1947. R.E.: The cornea is clear and measures 9.5 mm. in diameter. The anterior chamber is shallow. There are no posterior synechias, and the pupil dilates widely. There has been no change in the retrolental membrane.

L.E.: The left globe appears larger than the right. The cornea is clear and measures 10.5 mm. in diameter. The anterior chamber is very shallow. The pupil dilates poorly because of numerous posterior synechias. The iris is atrophic, especially temporally where it transilluminates brilliantly. There is a complete retrolental membrane with numerous small vessels on its surface. The tension is slightly elevated to fingers.

December 15, 1947. R.E.: The cornea is clear and measures 9.5 mm. in diameter. The anterior chamber is slightly shallow. There is a tendency toward doming of the iris, but there are no posterior synechias and the pupil dilates well. There is a small area at the 4-o'clock position where the retrolental membrane is thinner and through which a red reflex is visible. A few vessels are present on the surface of the membrane. Numerous short ciliary processes are visible. The tension is normal to fingers.

L.E.: There is slight erythema of the lids and faint pericorneal injection. The cornea is clear and measures 10.5 mm. in diameter. The anterior chamber is very shallow and there is marked doming of the iris. The pupil dilates irregularly because of numerous posterior synechias. The retrolental membrane is uniformly dense and still has a few vessels on its surface. The tension feels only slightly elevated to fingers.

Summary

1. Examinations were made of 120 children born between 1935 and 1944, whose birth weight was 2000 gm. (4½ lb.) or less. In this group no cases of retrolental fibroplasia were found.

2. Examinations were made of 214 children born between 1945 and 1947, whose birth weight was 2000 gm. (4½ lb.) or less. None of them had retrolental fibroplasia at birth. One hundred and eleven of these children were followed for six months or more. Five cases of retrolental fibroplasia developed in this group. The incidence of retrolental fibroplasia was 1.3 percent in the group weighing from 1360 to 2000 gm. (3 to 4½ lb.) at birth. The incidence of retrolental fibroplasia was 12.1 percent in the group weighing less than 1360 gm. (3 lb.) at birth.

3. The development of retrolental fibroplasia was followed in 9 premature infants. Retrolental fibroplasia developed in these infants between 2 and 5 months of age. All visible remains of the hyaloid system had disappeared before the onset of the disease. In these infants the initially normal fundus picture was replaced by an angiomatous dilatation of the retinal vessels, followed by massive retinal exudation, retinal detachment, and the formation of a retrolental membrane by fusion of the peripheral folds of detached retina.

4. The retrolental fibroplasia occurring in premature infants is not the result of persistence of the hyaloid system.

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Discussion

Dr. Arlington C. Krause (Chicago): Dr. Owens has observed clinically the initial process of one form of retrolental fibroplasia, which is a postnatal separation of the retina. In his presentation he has superbly shown in steps how this postnatal detachment takes place. In the paper which I have published in the *Archives of Ophthalmology* there are illustrations showing many postnatal retinal detachments of this nature. In the uncomplicated postnatal retinal detachment of the type described by Owens, no congenital retrolental fibroblastic tissue was observed in our clinic at any time clinically, nor was it seen in serial histologic sections of the initial process. Recently the retina in an eye was seen to reattach. The fluid which lifted the retina was clear and the interval of the time of separation was only a few weeks.

Those eyes which have a heavy fluid separating the retina tend to have the retina agglutinate, tend to have new blood vessels, and tend to have recurrent hemorrhages and to have complicated eye diseases. Those eyes which have a simple, clear fluid tend to have a clear retina behind it and in front of it which may possibly go back into place.

Some clarification of the terminology is needed, for retrolental fibroplasia is the name which has been applied to this type of retinal detachment, or rather separation, in premature infants. Terry also indicated he was not satisfied with this terminology.

First, if there is a persistence of the primary vitreous with or without retrolental hyperplasia and with or without the persistence of the hyaloid artery, then perhaps the disease may be called retrolental fibroplasia. This disease process may start before birth. I am sure that Dr. Reese and Dr. Owens would agree that, according to the histologic sections, the lesion of some eyes was present before birth.

Second, if the vasa hyaloidea arteria or one of the hyaloid branches is affected, then this disease may result in congenital retinal septa or folds. This process also occurs before birth.

Third, if the disease develops after birth, then commonly a retinal separation results. However, retinal separation is common with retinal septa and with hyperplasia and persistence of the primary vitreous. Retinal separation is the most common form seen at the University of Chicago clinics.

For all of these forms of retrolental fibroplasia the general term of ophthalmic dys-

plasia is preferable, because retrolental fibroplasia is an unsuitable name for retinal separation, folds, and septa. Furthermore, many times secondary pathologic processes grossly distort the clinical picture, and in time the whole eye is frequently smaller than normal and the vision is nil or only light perception.

Out of our 63 cases of fibroplasia no eye has normal or near normal vision. In some eyes the iris is fetal in structure and has a mesodermal dysplasia. In others the fundus is highly myopic or may be dysplastic. Often the eye is microphthalmic. In short, under retrolental fibroplasia, then, are a large number of developmental defects and many forms of this disease. Apparently the end result is dependent upon the time the etiologic agent affected the organic system. For example, retinal septa may arise in the 14- to 17-mm. stage of the fetus.

There is no clinical or pathologic evidence of fibroplasia in our clinic from 1928 to 1937—that is, by section of the eyes, by history, or by records. The first case occurred in 1937. Up to the present time 63 cases have been seen in the eye clinic. The general classification of these cases is: 36 cases of bilateral retinal separation, 3 cases of bilateral retinal separation with retrolental membrane, 3 cases of bilateral retinal separation with vitreous mass, 4 cases of bilateral retinal folds, 2 cases of bilateral retinal folds and separation, 5 cases of bilateral uveitis, 4 cases of retinal separation in one eye and retinal dysplasia in the other eye, and 6 cases not classified here.

Most of the cases are of the kind that Dr. Owens has discussed. Retinal dysplasia is common. The Terry-Reese type is rarely seen in this clinic.

Fibroplasia is often more than an eye disease. It reminds one of fetal rubella in which rubella cataracts are only a part of the disease. Fetal rubella may be accompanied by retarded growth, microcephaly, cardiac maldevelopment, low tone deafness, and dental aplasia. In fibroplasia, physical and mental development may be affected. In our group of cases of fibroplasia which are being followed from the prenatal period until death by our staff of specialists, the mental record is impressive.

Of 63 cases, about 26 are so far regarded as normal infants and children, except for blindness, or their mentality cannot be tested because of age or location. We are careful to separate mental retardation arising from blindness from nonocular mental retardation. Eighteen patients are mentally retarded; 19 are markedly mentally defective and many of these are in institutions for the feebleminded. Ten patients are dead.

The incidence of retrolental fibroplasia apparently varies with the community and the hospital. We may compare our ratio with that of Dr. Owens. On our obstetrical service the frequency has increased. The chances for fibroplasia in surviving premature infants with a birth weight below 1500 grams was 11 percent in 1945; in 1946, 36 percent; in 1947, 45 percent. So far in 1948, the incidence is 86 percent. In other words, it is increasing up to a maximum limit. We do not know the percentage of fibroplasia in our stillborn cases.

Dr. Owens mentioned various possible causes for fibroplasia. We have been unsuccessful in determining the etiology. Vitamin-A deficiency has been eliminated by Clifford. Poliomyelitis in pregnancy has no effect on the eyes. No drug used in pregnancy is associated with fibroplasia. In our clinic, fetal atelectasis with anoxia does not give rise to fibroplasia. Apparently virus pneumonia in pregnancy has no effect. Some modern procedure in the treatment of prematures may possibly be related to some forms of fibroplasia. There is some question about the effect of the exposure of these eyes to light and whether the light causes the fibroplasia. We have definitely found that fibroplasia develops in the dark. The effect of viruses, which we are trying to follow

now in pregnancy, may possibly give us the lead.

DR. A. B. REESE (New York): I have had an opportunity to read this paper and I wish to express my appreciation to the essayists for their kindness in sending it to me.

The Drs. Owens are the first to observe the development of retrolental fibroplasia, and their interesting and accurate observations are most valuable, indeed, for a better understanding of this disease.

I question the interpretation of their observations in two respects: first, that the lesion is acquired and, second, that the seat of the lesion is in the retina. They have examined premature infants shortly after birth, naturally without general anesthesia. Because the visible fundus was negative they have concluded that the lesion is acquired. Even in adults examined under the best of conditions there remain 4 mm. in the periphery of the retina inaccessible to view with the direct ophthalmoscope. Under the conditions necessary in examining newborn premature infants, one can see probably no further than the equator of the globe.

The Army Institute of Pathology, Dr. Bertha Klien of the Department of Ophthalmology, Northwestern University Medical School, Chicago, and the Department of Pathology of the Institute of Ophthalmology, New York, have pathology specimens of retrolental fibroplasia. I have had an opportunity to examine all of these.

These specimens, as well as the clinical course of the disease, indicate that the lesion in retrolental fibroplasia is located primarily in the periphery around the base of the vitreous and consists of vascularized fibrous tissue, or mesoderm, from which hemorrhage, organization, and detachment of the retina occur.

Our clinical observations have been on premature infants from 2 to 5 months old and none has been observed from birth. All of our cases have been examined under general anesthesia with dilated pupil, with a speculum to retract the lids, and with forceps with which to rotate the eye. Under these good conditions lesser degrees of this lesion may be so far in the periphery as to be difficult to see and may require the indentation of the sclera for their detection.

Factors indicating the congenital nature of this lesion are (1) that eyes affected with retrolental fibroplasia are frequently microphthalmic; (2) that in eyes with retrolental fibroplasia one frequently sees a pupillary membrane that stems from the collarette of the iris; (3) that congenital anomalies may be noted at sites other than the eyes; (4) that 20 percent of the patients with retrolental fibroplasia have skin hemangiomas present at birth. These skin hemangiomas show spontaneous regression. The normal incidence of skin hemangiomas in premature infants is 3.2 percent, and in full-term siblings 1.3 percent according to Hess, Mohr and Bartelme; therefore, the incidence of skin hemangiomas in patients with retrolental fibroplasia is considerably higher than that in premature infants in general.

When the retina is visible in cases of retrolental fibroplasia there is no evidence of angiomatosis. On the contrary, the blood vessels are attenuated, so that particularly the arterioles may be reduced to threadlike proportions or may even be difficult to see. It is my feeling, therefore, that in all cases of retrolental fibroplasia at least the matrix of the lesion is present at birth and consists of hemangiomatouslike tissues around the base of the vitreous with accompanying hemorrhage, organization, and detachment of the retina.

DR. WILLIAM C. OWENS (closing): I want to thank Dr. Krause and Dr. Reese for their interesting discussion of this subject.

Dr. Krause spoke of the presence of myopia in some of his cases. We have noticed a rapid development of myopia during the course of the disease. In the eyes in which the membrane was incompletely

formed, the patient had a residual myopia, which was probably of the axial type.

The increased incidence of retrolental fibroplasia in recent years at the University of Chicago, reported by Dr. Krause, is striking. In our experience over the past three years, the incidence of retrolental fiboplasia in children weighing less than 1360 grams (3 pounds) has remained essentially the same, varying between 15 and 20 percent. On the question of incidence, the clarification of one point is important. The incidence will vary depending upon whether only those cases with a complete membrane are counted, or whether all cases with incomplete membranes or partial residual manifestations are included. If the eyes with incomplete membranes or partial residua are included, our incidence will rise to 25 or 30 percent.

In some of our cases we have seen eyes with incomplete residual changes which resembled those shown by Dr. Krause as cases with "stalks" extending from the optic disc through the vitreous to the periphery of the fundus. We have seen several eyes in which this was the end result of the disease. Often such a picture was observed in one eye and the final result of the disease in the fellow eye was a complete classical retrolental membrane with vascularization, ciliary processes, and shallow anterior chamber.

Dr. Reese's discussion was interesting. One of the most important things in the interpretation of the pathologic material is the age of the patient at the time the enucleation was performed. If the enucleation, for instance, was performed as early as 1½ to 2 months after birth, the acquired changes we have described could be seen on histologic examination. But their presence would not be evidence that they were present at birth and not acquired. To say that a lesion present in an eye removed when the child is 4, 3, or even 2 months old is a lesion that has been present since birth is not necessarily correct. The lesion may have developed after birth, starting during the second month or earlier as we have observed in the cases we have followed. It is very important to know the age at which the eyes were removed in the cases Dr. Reese has examined histologically.

Dr. Reese points out the common association of microphthalmia in eyes with the fully developed retrolental membrane as evidence of the presence of the lesion at birth. In all the infants we have observed, none had microphthalmia at birth. The anterior segment measurements were the same as those of infants who did not develop retrolental fibroplasia. The microphthalmia develops in those eyes where a complete membrane forms. After the complete retrolental membrane has formed the eye stops growing. The microphthalmia was not a condition present at birth, but was the result of an arrest in growth and development which took place with the formation of the retrolental membrane.

In addition, Dr. Reese points out the small caliber of the retinal vessels in the late stages of cases with incomplete membranes. We have seen this develop after birth. In our cases, the retinal vessels appeared normal at birth. The first abnormality seen was a dilatation of the retinal vessels. The final small caliber of the vessels resulted from a decrease in size of the previously dilated vessels. It took place not only in the retinal vessels but also in the vessels of the retrolental membrane. In the later stages of the disease, as the acute phase subsided, there was a reduction in the size of the vessels whether they were in the retrolental membrane or in the retina.

The disease apparently has an acute onset, runs an active course, and then subsides. The final picture varies depending upon the severity of the acute phase, and the extent of contracture of the fibrous tissue formed.

Dr. Bedell asks if we have seen this condition develop in full-term infants. We have not.

PRACTICAL PROBLEMS PERTAINING TO PRESBYOPIA*

JAMES E. LEBENSOHN, M.D.
Chicago, Illinois

The presbyope who manages to break his glasses periodically takes the event cheerfully as he is rather aware that his eyes have changed since the last examination. Under the age of 60 years, some further loss of accommodation is normally expected, but equally significant, and sometimes more so, are the progressive changes in the static refraction that often develop in the presbyopic period and continue throughout life. The usual alteration is toward increasing hypermetropia and inverse astigmatism but refractive myopia is not infrequent. The following examples are typical:

CASE 1

Aged 40 years. R.E., +1.0D. sph., 20/20; L.E., +1.25D. sph., 20/20.

Aged 60 years. R.E., +2.75D. sph. ⊂ +0.5D. cyl. ax. 10°, 20/20; L.E., +3.25D. sph., 20/20.

CASE 2

Aged 73 years. R.E., + 2.25D. sph. ⊂ +0.5D. cyl. ax. 170°, 20/25; L.E., +1.75D. sph., 20/25.

Aged 81 years. R.E., +0.25D. sph., 20/25; L.E., −1.75D. cyl. ax. 105°, 20/40.

A man fully corrected for distance frequently does not require reading glasses until the age of 47 years. Paradoxically, although women have the greater life expectancy, they become presbyopic some years earlier.[1] Persons in the early forties who have not been previously examined should be refracted under cycloplegia. The full net correction may be adequate for all purposes and, if worn constantly, will facilitate the later wearing of bifocals. At the bifocal stage, the refractive error can be accurately and more conveniently determined by manifest refraction using primarily the Lancaster-Regan charts and checking with the cross cylinder.

A satisfactory arrangement for the presbyopes who have anisometropic myopia is simply fitting the least myopic eye for distance and the more myopic eye for near.[2] This method is successful when the corrected vision of each eye is approximately normal and a tendency to this type of alteration already exists. To the business woman concerned with the following correction this adaptation had the great advantage of not disclosing her physiologic age to her employer:

CASE 3

Aged 48 years. R.E., −0.5D. sph. ⊂ +1.0D. cyl. ax. 7.5°, 20/15; L.E., −1.75D. sph. ⊂ −1.75D. cyl. ax. 90°, 20/13.

Prescribed: R.E., unchanged; L.E., −1.75D. cyl. ax. 90°.

THE NEAR ADDITION

Life insurance tables list the average expectancy of life at a specified age but give no assurance that the data are valid for any particular case. Tables of accommodation likewise give a perspective but do no more.

TABLE 1

PRESBYOPIC ADDITION* AT VARIOUS DISTANCES

Distance	Vergence	Subtract
16"	2.5D.	0.25D.
18"	2.25D.	0.5D.
20"	2.0D.	0.75D.
23"	1.75D.	1.0D.
27"	1.5D.	1.25D.
32"	1.25D.	1.5D.
40"	1.0D.	1.75D.

* With addition at 14 inches (2.75D. vergence) as basis.

* From the Department of Ophthalmology, Northwestern University Medical School. Read before the Chicago Ophthalmological Society, April 19, 1948.

The accommodative amplitude of each individual presbyope must be precisely determined. Marked deviations from the average are not uncommon, as the following example illustrates:

CASE 4

Aged 58 years. R.E., +1.0D. sph. ⊃ 1.5D. cyl. ax. 180°, 20/13; L.E., +1.75D. sph. ⊃ +1.0D. cyl. ax. 180°, 20/13. Addition, +1.75D., reads 3-point type at 14 inches.

Slataper[3] has established that the reserve accommodation is uniformly one-diopter. The vergence at 14 inches is 2.75D. Consequently to read at this distance requires 3.75D. of total accommodation. Whatever deficiency exists indicates the presbyopic addition necessary. To determine this the present modification of my near-vision chart[4] provides three convenient checks—all done at 14 inches.

CHECK 1. THE TWO-LINE TEST

The test object consists of two parallel lines, 3-mm. long, 0.25-mm. wide, separated by 1 mm. In this test only the better eye is used, or if the eyes are equal, preferably that which is dominant. Minus 1D. is added to the distance correction to take care of the reserve accommodation. The patient views the two parallel lines which are now just a blur if he is truly presbyopic. The anticipated presbyopic correction less 0.75D. is added. Usually three lines will then be seen. The addition is increased, 0.25D. at a time, until the two lines are distinct. This is the presbyopic addition, with a possible error of 0.25D. The total accommodative power of the patient is 3.75D. minus the deficiency noted, and his available accommodation is exactly one diopter less. The presbyopic addition found is now added to the full distance correction in both eyes and further checked by the following two binocular tests.

CHECK 2. THE DUOCHROME TEST

Helmholtz believed that the center of the diffraction spectrum, 565 millimicrons, was the most sharply focused and that the boundary rays at the extremities formed aberration discs of equal diameter at the retinal plane. The "equal energy" luminosity curve, accepted by the International Commission on Illumination in 1924, confirmed Helmholtz's conception but placed the region of highest luminosity in the average eye at 555 millimicrons. In the distance duochrome test

Fig. 1 (Lebensohn). Presbyopia (from an old French print).

originated by Clifford Brown, in 1927, the colors used were 55 millimicrons equidistant from this wave-length.[5]

In 1928, Maddox[6] advised the duochrome principle for the measurement of the accommodative balance at a fixed convergence, and adapted for this purpose a black disc from the trial case on which was placed two tiny rectangles of red and green paper with a little black lettering on each. I have extended his idea to the reading chart. The color standards were selected by the Munsell Color Company who report that in the processed chart the dominant wave lengths of the red and green are respectively 595 and 509 millimicrons. With the right presbyopic correction the patient discerns the

figures on the red and green backgrounds equally well. If the correction is too weak, the figures on the green background will be more sharply seen; and vice versa. With the correct addition for 14 inches the same result follows as the chart is moved nearer and further from this distance.*

CHECK 3. FOUR-POINT TYPE

In the final and decisive test the patient studies the words in 4-point type. If the correction is precise he will definitely reject a binocular change of 0.25D. in either direction.

Since the patient's available accommodation is a constant, the presbyopic addition for any distance greater than 14 inches is found by simply subtracting from the determination at 14 inches the difference in the dioptric vergences of the two distances (Table 1).† For instance, a professional musician whose presbyopic addition at 14 inches was 2.25D. desired to read music on the grand piano at 32 inches. The dioptric vergences of 14 and 32 inches are 2.75 and 1.25 diopters, respectively. The difference, 1.5D., subtracted from 2.25D., is 0.75D., the required "music addition." Reading and occupational bifocals were prescribed as follows:

CASE 5

Pianist, aged 52 years. *(Bifocals for distance and reading).* R.E., −0.75D. sph. ⌒ +1.0D. cyl. ax. 90°, 20/13; L.E., +1.00D. sph ⌒ +2.25D. cyl. ax. 72.5°, 20/13. Addition, +2.25D., reads 3-point type at 14 inches. P.D., 66 mm. Displace segments in 2.2 mm.

Bifocals for music at 32 inches and keyboard. R.E., +1.00D. cyl. ax. 90°; L.E., +1.75D. sph. ⌒ +2.25D. cyl. ax. 72.5°. Addition, +1.5D. P.D., 64 mm. Displace segments in 1.2 mm.

The interpupillary distance is best measured with the corneal reflex as the point of reference. The direct measurement of the near P.D. is unnecessary as it can be more accurately deduced from the distance measurement. Merely divide the distance P.D. by the near distance in inches plus one, and the quotient is the difference in millimeters between the distance and near P.D. at the spectacle level. Thus in the preceding case where the distance P.D. was 66 mm. and the music distance 32 inches, 66 was divided by 33. The difference, 2 mm., substracted from 66 gave the P.D. for the music glasses (fig. 2).

The status of the muscle balance must be considered in the final prescription.[2] The lateral phorias are determined with the distance and near corrections set respectively at the correct P.D., but for hyperphoria the testing is more exact if made without lenses. Relevant to this subject are the following:

CASE 6

Aged 47 years. R.E., −2.50D. sph. ⌒ +6.5D. cyl. ax. 122.5°, 20/30; L.E., +2.5D. sph. ⌒ +0.25D. cyl. ax. 105°, 20/15. Addition, +1.0D.

Hypophoria: Distance—R.E., 2.5Δ base up. Near—none. Incorporating the prism in the distance lens corrects the distant muscle imbalance and practically equalizes the vertical prismatic power created by the lenses at 8 mm. Reading depth: R.E., −2.9Δ base up.

CASE 7

A physician, aged 48 years, could not study comfortably because of an exophoria for near of 16Δ. A cinch operation on the

* The distance point of equal sharpness in the duochrome test will vary somewhat with the illumination in use.

† An alternative and simpler method is to subtract the available accommodation as determined at the reading distance from the dioptric vergence of the other working distance. In the case cited the available accommodation was 0.5D.—the vergence of 14 inches, 2.75D., less the presbyopic addition, 2.25D. Subtracting 0.5D. from 1.25D., the vergence of 32 inches, gives 0.75D., the required addition for that distance.

left internal rectus resulted in distance esophoria 5.5$^{\Delta}$ and near exophoria 6.5$^{\Delta}$. He had been given separate glasses for distance and near, with 2$^{\Delta}$ base out in each distance lens, to compensate for the esophoria which he could not tolerate, but later insisted on bifocals.

The refractive error was: R.E., +2.00D. sph. $\bigcirc$ +2.0D. cyl. ax. 82.5°, 20/20; L.E., +3.0D. sph. $\bigcirc$ +1.5D. cyl. ax. 70°, 20/20. Addition, +1.75D.

By changing the distance P.D. from 65 to 70 mm., and displacing each segment in 5.25 mm., he obtained bifocals that were worn comfortably. In such cases prisms base-in in the segments would probably be more advisable than operative intervention.*

Choice of bifocals

The proper selection of bifocals involves various factors: jump, displacement in the reading field, and equalization of incidental vertical and horizontal prismatic effects. The jump in passing from distance to near vision occurs at the upper edge of the segment and depends on its distance from the optical center of the segment. The less this distance is, the less the jump. For waitresses, railroad conductors, truck drivers, and others, who move about rapidly and read only occasionally, minimal jump is the most important consideration.

For those doing prolonged near work, however, the emphasis should be placed on minimal reading displacement. The line of vision in reading averages 8 mm. below the optical center of the principal lens. At this point a plus distance correction has base-up prismatic power which can be neutralized by the base-down effect of the segment if properly chosen and avoid thereby displacement in the reading field. The segment that achieves this purpose depends on the ratio of the power of the distance lens measured in the vertical meridian to the presbyopic addition. If the segment top is placed 3 mm. below the optical center of the principal lens, as is the standard practice, there will be a minimal reading displacement if the selection of segments is made according to the following ratios (Table 2):

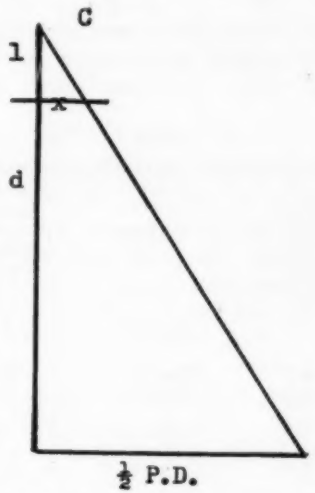

Fig. 2 (Lebensohn). From the center of rotation of the eye the visual lines for distance and near make similar triangles at the spectacle and reading levels. Hence $\frac{l}{1+d} = \frac{x}{½\ \text{P.D.}}$

In Case 5, the near-vision line for 32 inches is thus displaced in at each lens 1/33 of 33 mm. or 1 mm.

When in doubt as to the choice of bifocal that with the smallest radius, and consequently the least jump, is to be preferred. The available segments give but slight compensation for the base-down action of a minus lens. In the Panoptik or Fulvue, as Table 2 shows, only −0.5D. is compensated by a 2.5D. addition. Consequently for high myopia, the Myodisc bifocals, which have the distance and near portions independently centered, are advisable; or both lenses can have a compensating slab-off prism in the

* An excellent cosmetic effect is achieved for prisms base-in in the segments in the Conaccor bifocal (Belgard, Inc.) in which the segment extends to the nasal edge of the lens and so conceals the prism edge.

lower portions,—a construction more cosmetic and effective than prisms base-up in the segments. In additions of 2.50D. or over, where chromatic aberration must be considered, the one-piece bifocals are preferable.

Anisometropia

When the two lenses have unequal power in the vertical meridian, an artificially created vertical imbalance results at the reading depth which causes trouble unless compensated. This compensation can be effected by three methods: (a) dissimilar segments, (b) bicentric ("slab-off") grinding, (c) prism segment bifocals. Of these, dissimilar segments have the advantage of being simpler, less expensive, and more readily available than the other methods. The patient's coöperation is easily obtained if the prescriber explains that, since the eyes are different, each eye must have a different type bifocal, but that the difference will be unnoticeable when the glasses are worn.

TABLE 2

Ratios to use in selection of segments

Distance from Top of Segment to its Optical Center (mm.)	Segment Type	Ratio of Vertical Distance Power to Addition
3.5	Panoptik Fulvue	−1/5
4.5 5.0	Ultex K Univis D	0
7.0	Univis R	1/4
8.0	Orthogon C	1/3
10.0	Orthogon D	2/3
11.0	Kryptok Ultex B	3/4
16.0	Ultex E	4/3
19.0	Ultex A	7/4

To use dissimilar segments, simply divide the prismatic difference at the reading depth by the presbyopic addition. The answer gives the millimeters difference between the optical centers required for compensation. From Table 2 the most suitable segments with this difference, or nearest it, are selected. The segment with the largest radius must go with the lens having in the vertical meridian the greatest plus power or the least minus power. The following examples illustrate the figuring:

Case 8

Aged 47 years. R.E., +1.75D. sph. ⊂ +1.25D. cyl. ax. 150°, 20/25; L.E., +2.75D. sph. ⊂ +1.75D. cyl. ax. 170°, 20/25. Addition, +1.5D.

Vertical prismatic power of sphere and cylinder at 8 mm.: R.E., 1.6$^{\Delta}$ +0.64$^{\Delta}$, totalling 2.24$^{\Delta}$ base up; L.E., 2.2$^{\Delta}$ +0.81$^{\Delta}$, totalling 3.01$^{\Delta}$ base up. Difference, 0.77$^{\Delta}$, divided by 1.5D., equals 5 mm.

Order: R.E., Ultex B (radius 11 mm.), L.E., Ultex E. (radius 16 mm.).

Case 9

Aged 52 years. R.E., Plano, 20/20; L.E., +1.25D. sph. ⊂ +1.25D. cyl. ax. 180°, 20/20. Addition, +2.25D.

Vertical prismatic power of sphere and cylinder at 8 mm.: R.E., Zero; L.E., 2$^{\Delta}$ base up. Difference, 2$^{\Delta}$, divided by 2.25D., equals 8.8 mm. Nearest difference in tables, 7.5 mm. Corrects, 2.25D. × 0.75, or 1.7$^{\Delta}$ of the 2$^{\Delta}$ needed.

Order: R.E., Fulvue (3.5 mm.); L.E., Kryptok (11 mm.).

Case 10

Aged 46 years. R.E., +0.75D. sph., 20/15; L.E., +3.5D. sph. ⊂ +1.75D. cyl. ax. 122.5°, 20/20. Addition, +1.25D.

Vertical prismatic power of sphere and cylinder at 8 mm.: R.E., 0.6$^{\Delta}$ base up; L.E., 3.36$^{\Delta}$ base up. Difference 2.76$^{\Delta}$. Greatest difference in tables, 15.5 mm. Corrects, 1.25D. × 1.55 or 1.94$^{\Delta}$ of the 2.76$^{\Delta}$ needed.

Order: R.E., Fulvue (3.5 mm.); L.E., Ultex A (19 mm.).

By bicentric grinding the slab-off can provide 1.5$^{\Delta}$ to 5.0$^{\Delta}$ base up over the entire lower field of one lens, and consequently is particularly suited for anisometropic myopia. The machinist, whose report follows, had had a hypermetropia of 1.0D. sph. in each eye until he reached the age of 55 years but, since then, the right eye has become increasingly myopic. Binocular vision was essential for his work.

CASE 11

Aged 60 years. R.E., −4.0D. sph. ⌒ −1.0D. cyl. ax. 20°, 20/20; L.E., +1.25D. sph., 20/13. Addition, +2.5D.

Vertical prismatic power of sphere and cylinder at 8 mm.: R.E., 3.9$^{\Delta}$ base down; L.E., 1.0$^{\Delta}$ base up. Difference, 4.9$^{\Delta}$, corrected by slab-off in right lens. Appearance, good.

Dissimilar segments with slab-off can be used for their combined effect as in the following:

CASE 12

Aged 50 years. R.E., −0.5D. sph. ⌒ −0.5D. cyl. ax. 105°, 20/15; L.E., −8.25D. sph. ⌒ −3.25D. cyl. ax. 180°, 20/40. Addition, +2.25D.

Vertical prismatic power of sphere and cylinder at 8 mm.: R.E., 0.43$^{\Delta}$ base down; L.E., 9.20$^{\Delta}$ base down. Difference 8.77$^{\Delta}$. Order: R.E., Ultex A; L.E., Fulvue, corrected 3.5$^{\Delta}$; L.E., slab-off 5$^{\Delta}$; total 8.5$^{\Delta}$. Bifocals were worn successfully. The patient had been told previously that the left eye could not be fitted, as the eyes would not then work together.

Some cases of marked anisometropia, as in the following example, have a negligible difference in prismatic power in the vertical meridian, and hence can be fitted similarly with the indicated bifocal.

CASE 13

Aged 63 years. R.E., −0.25D. sph. ⌒ −1.25D. cyl. ax. 102.5°, 20/13; L.E., −1.25D. sph. ⌒ +4.5D. cyl. ax. 60°, 20/25. Addition, +2.5D. reads 3-point type at 14 inches.

Vertical prismatic power of sphere and cylinder at 8 mm.: R.E., 0.2$^{\Delta}$ +0.004$^{\Delta}$, totalling 0.204$^{\Delta}$ base down; L.E., 1.0$^{\Delta}$ base down +0.61$^{\Delta}$ base up, totalling 0.39$^{\Delta}$ base down. Difference, 0.196$^{\Delta}$. Order: Ultex K, both eyes.

HORIZONTAL PRISMATIC EFFECTS

With an indicated displacement of 2 mm. in, a distance lens of +2.0D. has a prismatic action of 0.4$^{\Delta}$ base out at the reading point. This would cause the visual line to deviate 4 mm. out at one meter. Since the center of rotation of the eye is 25 mm. from the spectacle level, the displacement at this point is 25/1,000 (1/40) of 4 mm. or 0.1 mm. To compensate for such shifts the segment must be displaced further in 0.1 mm. for every 0.4$^{\Delta}$ base out in the horizontal meridian, and, vice versa, for every 0.4$^{\Delta}$ base in, the displacement should be reduced 0.1 mm.

John Neill, a teacher of geometric optics, noted in 1926 that at the reading point the prismatic effect of cylinders at axes other than 90° and 180° is considerably influenced by the 2-mm. displacement, and especially so as regards the prismatic effects in the horizontal meridian.* His calculations showed that the same cylinder axis then affects the right and left eye differently, and that the prismatic action in the horizontal meridian may be base out or base in according to the position of the cylinder axis. The accompanying Tables 3 and 4 are only illustrative. Complete data are available for all the reading depths.[7]

* Fortunately the effect of displacement in the vertical meridian of cylinders with oblique axes can be accurately enough calculated from the currently available Euler's tables by simply using the dioptric values obtained after subtracting 5 degrees from the original cylinder axis in the right eye, and adding 5 degrees to the original cylinder axis in the left eye.

Subnormal vision

Most patients are more interested in seeing clearly at near than at distance, but the relative acuity at near can be no greater than the efficiency of the corrected distance vision.[4] With 20/20 vision or better, 4-point type can be read at 16 inches. If the visual acuity is 20/40, which represents a visual efficiency of 83.6 percent, the reading distance, as reduced by this percentage, will be 13 inches. With 20/50 vision, the visual efficiency is 76.5 percent and the reading distance is reduced to 12 inches. As the dioptric vergence of 12 inches is 3.25D., the presbyopic addition for this distance must be increased proportionately. On account of convergence strain an addition of 3.25D. is probably the limit for comfortable binocular vision, but for monocular vision up to 10.0D. addition may be used, the strong addition acting then as a loupe or spectacle-borne magnifier. The magnification that occurs in adds over 4.0D. is the dioptric value of the total addition divided by four. With the object at the anterior focal point of the loupe the posterior rays are parallel. Hence no accommodation need be used, and the distance of the lens from the eye is immaterial.

TABLE 3

Vertical prismatic effects of 1.0D. cylinder at various axes at 1-cm. reading depth

Corrected for Displacement 2 mm. In						From Euler's Theorem Without Correction
Axis	R.E.	L.E.	Axis	R.E.	L.E.	
0	1.00$^{\Delta}$	1.00$^{\Delta}$	180	1.00$^{\Delta}$	1.00$^{\Delta}$	1.00$^{\Delta}$
10	1.00$^{\Delta}$	0.94$^{\Delta}$	170	0.94$^{\Delta}$	1.00$^{\Delta}$	0.97$^{\Delta}$
20	0.95$^{\Delta}$	0.82$^{\Delta}$	160	0.82$^{\Delta}$	0.95$^{\Delta}$	0.88$^{\Delta}$
30	0.84$^{\Delta}$	0.66$^{\Delta}$	150	0.66$^{\Delta}$	0.84$^{\Delta}$	0.75$^{\Delta}$
40	0.68$^{\Delta}$	0.51$^{\Delta}$	140	0.49$^{\Delta}$	0.68$^{\Delta}$	0.59$^{\Delta}$
50	0.51$^{\Delta}$	0.34$^{\Delta}$	130	0.32$^{\Delta}$	0.51$^{\Delta}$	0.41$^{\Delta}$
60	0.34$^{\Delta}$	0.18$^{\Delta}$	120	0.16$^{\Delta}$	0.34$^{\Delta}$	0.25$^{\Delta}$
70	0.18$^{\Delta}$	0.06$^{\Delta}$	110	0.05$^{\Delta}$	0.18$^{\Delta}$	0.12$^{\Delta}$
80	0.06$^{\Delta}$	0.00$^{\Delta}$	100	0.00$^{\Delta}$	0.06$^{\Delta}$	0.03$^{\Delta}$
90	0.00$^{\Delta}$	0.00$^{\Delta}$	90	0.00$^{\Delta}$	0.00$^{\Delta}$	0.00$^{\Delta}$

TABLE 4

Horizontal prismatic effects of +1.0D. cylinder at various axes at 1-cm. reading depth

Corrected for Displacement 2 mm. In						From Euler's Theorem Without Correction
Axis	R.E.	L.E.	Axis	R.E.	L.E.	
0	0.000$^{\Delta}$ b.o.	0.000$^{\Delta}$ b.i.	180	0.000$^{\Delta}$ b.i.	0.000$^{\Delta}$ b.o.	0.000$^{\Delta}$ b.o.
10	0.177$^{\Delta}$ b.o.	0.165$^{\Delta}$ b.i.	170	0.165$^{\Delta}$ b.i.	0.177$^{\Delta}$ b.o.	0.006$^{\Delta}$ b.o.
20	0.345$^{\Delta}$ b.o.	0.298$^{\Delta}$ b.i.	160	0.298$^{\Delta}$ b.i.	0.345$^{\Delta}$ b.o.	0.024$^{\Delta}$ b.o.
30	0.483$^{\Delta}$ b.o.	0.383$^{\Delta}$ b.i.	150	0.383$^{\Delta}$ b.i.	0.483$^{\Delta}$ b.o.	0.050$^{\Delta}$ b.o.
40	0.575$^{\Delta}$ b.o.	0.410$^{\Delta}$ b.i.	140	0.410$^{\Delta}$ b.i.	0.575$^{\Delta}$ b.o.	0.082$^{\Delta}$ b.o.
50	0.610$^{\Delta}$ b.o.	0.375$^{\Delta}$ b.i.	130	0.375$^{\Delta}$ b.i.	0.610$^{\Delta}$ b.o.	0.118$^{\Delta}$ b.o.
60	0.583$^{\Delta}$ b.o.	0.283$^{\Delta}$ b.i.	120	0.283$^{\Delta}$ b.i.	0.583$^{\Delta}$ b.o.	0.150$^{\Delta}$ b.o.
70	0.498$^{\Delta}$ b.o.	0.145$^{\Delta}$ b.i.	110	0.145$^{\Delta}$ b.i.	0.498$^{\Delta}$ b.o.	0.176$^{\Delta}$ b.o.
80	0.365$^{\Delta}$ b.o.	0.223$^{\Delta}$ b.o.	100	0.023$^{\Delta}$ b.o.	0.365$^{\Delta}$ b.o.	0.194$^{\Delta}$ b.o.
90	0.200$^{\Delta}$ b.o.	0.200$^{\Delta}$ b.o.	90	0.200$^{\Delta}$ b.o.	0.200$^{\Delta}$ b.o.	0.200$^{\Delta}$ b.o.

Instead of prescribing a separate pair of magnifying glasses, advantage can be taken of an inexpensive device widely used by watchmakers, known as Behr's spectacle loupe (fig. 3). This is simply a magnifiying glass attached by a swivel clip to the distance lens of the better eye, which can be immediately rotated in or out of position, or if desired, removed entirely.

These loupes are listed according to their

focal length in inches. Only the longer foci —6, 5, and 4 inches—are useful in this connection, which lenses correspond to 7.0D., 8.0D., and 10.0D., and provide a magnification of 1.75, 2.0, and 2.5, respectively. In

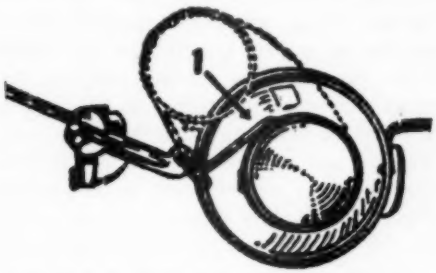

Fig. 3 (Lebensohn). Behr's spectacle loupe.

cost, weight, size, and appearance this spectacle loupe is preferable to telescopic spectacles or a telescopic attachment.

All such devices, to be used successfully, require that the patient move the paper or book rather than his head or eyes. The following example shows the value of magnifying glasses:

CASE 14

Aged 52 years. Eyes scarred from gonorrheal ophthalmia. Vision in better eye 20/200, uncorrectable. With a +10.0D. sph. reads 6-point type at 4½ inches.

TRIFOCALS

Trifocals are seldom indicated if the addition is less than 1.5D. Above that, the intermediate focus is needed by many persons, such as office managers, druggists, grocers, printers, machinists, switchboard operators, and cardplayers. The intermediate power is set at about one half of the presbyopic addition in most of the fused and one-piece types, the principal exception being the Panoptik where the ratio is five eights. The following table used in Ultex trifocals is typical:

READING ADDITION	INTERMEDIATE POWER
1.0D.	0.5D.
1.25D.	0.62D.
1.5D.	0.87D.
1.75D., 2.0D., 2.25D., 2.5D., and up	1.12D.
	1.37D.

The trifocal is experiencing a rapid acceleration of acceptance, the present use being over 12 times that of 1940. Due to the projection of the visual angle, an intermediate band of 6 mm. in the lens gives approximately the same vertical field at 28 inches that the reading segment gives at 14 inches. In the fitting of trifocals, if the top of the 6-mm. intermediate band is set at the level of the lower margin of the pupil, the top of the reading segment should remain at its usual position. In selected cases of aphakic correction the trifocal should be of value.

The Beach multifocal lens looks like a simple lens, and as its character escapes ordinary inspection, it conceals the presbyopic age. The outside blended area is constructed of varying focal lengths graduated from near to far, and the prescription, including cylinder and prism when indicated, is inside surfaced. Although production is limited and distribution restricted, the inventor has informed me that several thousand persons are wearing this lens successfully. A priori it seems that some confusion would result from the rapid change in curvature as the eye moves from place to place, but the patient becomes rather well adapted to the multifocal feature and finds that a reduced reading field is its chief practical limitation.*

* Using a 2.0D. presbyopic addition, I find the Beach lens quite as effective as my previous trifocals. I wear them constantly and am not conscious of a reduced field nor troubled by confusion. The Beach lens like the standard trifocals has the intermediate power above that for reading. Where it is necessary to have this relation reversed, as for furniture polishers and others working in a standing position, this can be accomplished by the Accon trifocals (Uhlemann) in which both segments are independently ground, and can hence be prescribed in any desired power and position.

Concluding Hints

To safeguard against error the prescriber should himself transpose the final prescription remembering that the toric surface in one-piece bifocals is plus, and in fused bifocals minus. In monocular vision, if the seeing eye is fitted with a bifocal, the amaurotic eye requires for cosmetic purposes only the spherical equivalent of the distance correction. After the spectacles are obtained, both the prescription and the fit should be checked. The closer the lens is to the eye, the wider the reading field. By narrowing or widening the bridge, the optician can raise or lower the position of the segment in relation to the eye according to the needs of the patient. A round-top bifocal ordinarily should be set at the level of the upper margin of the lower lid, and a straight-top bifocal, 1 mm. lower.* Patients should be cautioned that fused-segment bifocals scratch easily and deserve as careful handling as a photographic lens. A grab-front, or a flip-up frame, with the add in the flip-up, is a useful arrangement for roentgenologists and others who must observe near objects at eye level.

The requirements of the patient's job must be clearly understood as patients are generally more interested in working vision than in reading. A carpenter would rather have a greater range with less acuity than the reverse. A performer at a grand piano requires a different focus than one at an upright. A man who works standing, like a presser or cutter, usually requires about 1.0D. less than his reading addition, the exact difference depending on his height, and will be best satisfied with occupational bifocals and a separate pair of reading glasses. Many women want an all-purpose glass that will allow them to iron and sweep as well as read. A suggested solution is the "see-step" Ultex or Univis B in which the distance portion is both above and below a reading band. Such a type is also excellent for golfers.

The patient who would wear bifocals successfully must learn to move his eyes rather than his head in changing from distance to near vision. Confusion is eliminated if the usual habit of keeping the head up in walking and down in reading is to some extent reversed. When the bifocals are right, and the patient uses his head—as directed—there should be but little difficulty in the process of adjustment.

4010 West Madison Street (24).

* Only bifocals above 0.75D. addition are kept in standard stock, but it is seldom desirable to prescribe aught weaker.

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AN EVALUATION OF AN ANTIHISTAMINIC DRUG IN EXPERIMENTAL UVEITIS*

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Uveitis is believed in many instances to be a phenomenon of hypersensitivity.[1] The numerous observations on individual idiosyncrasy toward generally harmless substances remained uncorrelated and uninterpreted until the classical studies of Von Pirquet and Schick. They, through a thorough examination of the phenomenon of serum sickness, perceived the underlying antigen-antibody nature of hypersensitiveness to both inanimate protein agents and invasive bacteria. They introduced the term allergy which is used most frequently to refer to conditions of hypersensitiveness in human beings only. It defines a group of biologic responses in which body tissues have been so altered by previous contact with an antigen that their subsequent reactions to the same inciting agent may be entirely different from those produced by the initial contact.

These subsequent reactions following the altered reactivity of the tissues may take many forms. These may vary from a mild evanescent wheal and erythema reaction to a severe local tissue destruction. The subcutaneous injection of a minute quantity of ragweed pollen into a sufferer of vasomotor rhinitis will produce localized erythema and wheal reaction that disappears quickly.

A more intense form of allergic reaction may be induced in many persons by repeated subcutaneous injections of a protein. This latter is the Arthus phenomenon that may end in local tissue necrosis. These two phenomena can usually be distinguished clinically and experimentally. However, in the allergy due to chronic bacterial infection a more complicated pathologic process may be present. In such instances it is difficult to determine the respective role played by the specific bacterial excitant and the allergy to it in the production of the pathologic process.

Woods[1] has recently reviewed this subject and believes that hypersensitivity may be divided into the anaphylactic state and the hypersensitivity of infection.

The anaphylactic state is a form of hypersensitivity which results when foreign protein is reintroduced into sensitized tissues. This reaction is characterized by a quick onset after the reintroduction of the foreign protein, by spasmodic contraction of smooth muscle, and by an increase in capillary permeability. This type of hypersensitivity can be transferred and is usually accompanied by the presence of specified precipitins in the body fluids. The reaction to horse serum, pollen, and the Arthus phenomenon, Woods includes as examples of the anaphylactic type of hypersensitivity.

The bacterial type of hypersensitivity is not characterized by the presence of precipitins in the blood serum and it cannot be passively transferred. It is produced by sensitizing the tissue to bacterial bodies, but the actual reaction can be produced not only by the bacterial bodies but also by soluble bacterial proteins.

There is some evidence which suggests that the anaphylactic type of reaction is due to a release of histamine. The bacterial type of hypersensitivity may be due to histamine release but the evidence is less convincing.[2]

Many attempts have been made to control the anaphylactic type of hypersensitivity reaction by detoxifying or by building up the tissue resistance to the histamine released.

One method utilized an enzyme found in

* From the Department of Ophthalmology, Hospital of the University of Pennsylvania.

the intestinal mucosa of hogs, histaminase, that hydrolyzed histamine into inert substances.[3, 4] Another tried to build up a tissue tolerance of histamine by repeated injections of increasing strengths of histamine.[4, 5] This did not produce antibodies against histamine because histamine is not an antigen. In an effort to develop antibodies against histamine, hapamine was used. This is histamine conjugated with a protein that possesses antigenic activity.[6] The most recent method has been the utilization of antihistaminic drugs. Many have been developed such as Antergan, Antistine, Benadryl, and Pyribenzamine.[7-9] They all have some untoward, undesirable effects. Of these methods the antihistamine drugs appear to be the most promising.

It seemed worthy to evaluate an antihistaminic drug for its ability to control ocular anaphylactic involvement particularly in relation to diseases of the uveal tract.

Method

The anaphylactic type of reaction was chosen for study. There is more evidence that histamine release is responsible for this type of reaction than for the bacterial type of hypersensitivity. Such a reaction can be induced by injecting a foreign protein such as horse serum into the eye. This sensitizes the ocular structures. The second injection is given 10 days later intravenously. A prompt vigorous inflammatory reaction follows. This type of reaction has been demonstrated by many.[10-13]

Twenty-nine rabbits were used in this study. Fifty-eight rabbit eyes received an intravitreal sensitizing dose of 0.1 cc. of horse serum. Ten days later an intoxicating dose of 1 cc. of horse serum was injected intravenously.

Five rabbits each received a 4 mg. (kilo) dose of Pyribenzamine* intramuscularly six hours before the intoxicating injection of horse serum.

Five rabbits each received a 4 mg. (kilo) dose of Pyrabenzamine intramuscularly at the same time as the intravenous horse serum. The Pyribenzamine dosage was repeated at 4-hour intervals for three more doses.

Five rabbits received 4 mg. (kilo) dosage of Pyribenzamine intramuscularly 24 hours after the intoxicating dose of horse serum.

Three rabbits received 0.5 cc. of 0.2-percent Pyribenzamine distilled-water solution subconjunctivally. These injections were made only in one eye, the other acted as control.

Three rabbits received 0.5 cc. of 0.2-percent solution of Pyribenzamine subconjunctivally at the same time as the intoxicating dose of horse serum. Only one eye of each rabbit was injected subconjunctivally.

Three rabbits received 0.5 cc. of 0.2-percent solution of Pyribenzamine subconjunctivally six hours after the intoxicating dose of horse serum. Only one eye of each rabbit was injected subconjunctivally.

Five rabbits received horse serum injections but no Pyribenzamine.

There were 19 control eyes that received no Pyribenzamine therapy and 39 eyes that were exposed to some form of Pyribenzamine treatment.

Results

All eyes except the 10 treated by systemic Pyribenzamine prior to intoxicating injections showed varying degrees of edema of the iris, engorgement of iris vessels, edema of the conjunctiva, hemorrhages in the iris and conjunctiva, conjunctival discharge, and aqueous changes. All signs developed within two hours after injection. The majority of these eyes were quiet within two weeks.

Of the 10 eyes treated with Pyribenzamine prior to the second injection of horse serum, two showed slight iris hyperemia and conjunctival injection. The others were

* Pyribenzamine for the work was supplied by Ciba Pharmaceutical Products, Inc., Summit, New Jersey.

clear. At 24 hours all of these eyes were clear.

The 10 eyes treated with Pyribenzamine intramuscularly simultaneously with the second horse serum injection showed iritis of mild to severe degree, conjunctivitis, and conjunctival edema. Five eyes had lid edema and conjunctival discharge. Eight of these eyes quieted within two weeks and showed only a few posterior synechias; one eye had a persistent active uveitis and the 10th one showed corneal vascularization as well as a persistent severe uveitis.

The 19 control eyes behaved similarly to the ones just described, showing iritis of severe to mild degree persisting for at least 48 hours and gradually subsiding in two weeks. At the end of that time 9 of the eyes showed posterior synechias.

The 10 eyes treated 24 hours after the intoxicating dose of horse serum acted similarly to the control eyes. Six of the 10 eyes showed synechias after two weeks. All 10 presented marked uveitis and conjunctivitis after two hours, persisting in severe form for 48 hours.

The 3 eyes treated with subconjunctival Pyribenzamine prior to the time of injection and the 3 eyes treated six hours later showed even more severely engorged iris and conjunctivitis than the control sides. The conjunctival edema at the sites of injection was more marked than the surrounding conjunctiva. All of these eyes showed synechias after two weeks and some patches of iris atrophy.

No significant change could be noted in the degree of the ocular reaction in the eyes of those rabbits that were given a second intramuscular injection of Pyribenzamine as compared to the untreated controls.

Discussion

It is evident from these data that Pyribenzamine administered intramuscularly prior to the intoxicating dose of horse serum had a significant detoxifying effect. Local subconjunctival injections of Pyribenzamine when used before the intoxicating injection had no beneficial effect. Subconjunctival use of Pyribenzamine in the dosage employed enhanced the severity of the conjunctival reaction. Pyribenzamine given intramuscularly at various time intervals from the moment of the intoxicating injection of horse serum to 24 hours after the injection had no significant influence on the ophthalmic reaction.

Several points must be considered in evaluating this data. The failure of the Pyribenzamine therapy in this anaphylactic type of uveitis cannot be attributed to the inability of Pyribenzamine to penetrate from the blood stream into the ocular structures.

McGavack's[14] studies showed that Pyribenzamine penetrated readily into the cerebrospinal fluid from the blood stream. The blood-aqueous barrier has been shown on many occasions and for many compounds to be similar to the blood-cerebrospinal fluid barrier. This similarity has been demonstrated for the sulfonamides, penicillin, and streptomycin.

In addition, Pyribenzamine was able to penetrate sufficiently when given prior to the intoxicating injection of horse serum. Also, penetration should be better when the eye is inflamed. However, in inflamed eyes the Pyribenzamine had no effect. It is conceivable that the systemically liberated histamine tied up most of the circulating Pyribenzamine and thus little was available for intraocular penetration.

This implies that larger doses of Pyribenzamine might be more helpful. However, the doses used here would correspond to larger doses than usually used clinically. In addition, repeated administrations of Pyribenzamine were not significantly helpful. It is quite possible, however, that the route chosen for local administration may not have allowed adequate intraocular penetration.

These preliminary studies indicate that the anaphylactic type of ocular hypersensi-

tivity reaction can be prevented by antihistaminic drugs but cannot be treated successfully once the ophthalmic reaction has been established.

These observations may be of some value in suggesting a method of alleviating endophthalmitis phaco-anaphylactica and sympathetic ophthalmia. In both of these instances antihistaminic drugs can be administered prior to the possible onset of the ocular reaction. It may be advisable to give antihistaminic drugs pre- and postoperatively in all cataract extractions, particularly when extracapsular extraction may occur. In ocular injuries, especially when the uveal tract and the lens are injured, it may prove helpful to administer antihistaminic drugs.

Conclusions

1. Systemically administered Pyribenzamine prevented the development of an anaphylactic type of uveal inflammation when given prior to the toxifying injection of horse serum.

2. Systemically administered Pyribenzamine failed to clear up the anaphylactic type of uveal inflammation when given simultaneously with the intoxicating injection of horse serum, when given after the intoxicating injection, and when repeated.

3. Local Pyribenzamine by subconjunctival injection failed to prevent or clear the anaphylactic uveal reaction when given before or after the intoxicating intravenous injection of horse serum.

1930 Chestnut Street (3).

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OCULAR MANIFESTATIONS OF PEMPHIGUS FOLIACEUS*

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INTRODUCTION

The study of pemphigus foliaceus, named "fogo selvagem" by Brazilian authors, assumes a great importance in this country, due to its remarkable incidence, its seriousness, and the epidemiologic problems which it presents.

Numerous studies have been carried out on the subject of these dermatoses, and considerable bibliographic information may be found in the articles by Caramuru Pais Leme and Gil Cerquerira. The multiple aspects of this interesting and complex problem are analyzed in the recent publications of Profs. Alexandre Cerqueira, Rabelo Filho, Mário Artom, João Paulo Vieira, A. Aleixo, Lindenberg, Olinto Orsini, Paranhos and Bertarelli, and Drs. B. Mourão, N. Alayon, L. Gualberto, and others.

The existence of various epidemic foci, particularly in the states of São Paulo and Minas Gerais, the greater incidence during prepuberty and adolescence (European pemphigus foliaceus chiefly affects adults), the feverish beginning, the steady thermic curve, and especially the more benign clinical evolution of Brazilian pemphigus, together with the greater frequency of the mild forms that it presents, constitute, according to Artom, sufficient signs to distinguish the so-called "fogo selvagem" from Cazenave's pemphigus foliaceus and to separate it as an individual nosologic entity.

Recently Artom, Rabelo Júnior, and João Paulo Vieira pointed out the similarity existing between some cases of Brazilian pemphigus foliaceus and the syndrome named after Senear and Uscher, especially when the presence of the "butterfly" formations that have been observed in certain forms of facial lupus erythematosus were noted. This theory is further supported by anatomicopathologic examination. However, due to the small number of cases observed, we cannot include the entire group of Brazilian pemphigus foliaceus in the Senear and Uscher syndrome.

Many authors differ regarding the terminology of this morbid form. Rabelo Júnior prefers to call it "American pemphigus foliaceus"; Paranhos, Pedroso, Artom, and Guimarães call it "tropical pemphigus"; and João Paulo Vieira calls it simply "pemphigus foliaceus," which term has been adopted by us in this study.

Among the researches concerning the etiology of the disease, those carried out by Benedito Mário Mourão have been especially interesting. He disclosed as a pathogenic element a streptococcus with peculiar characteristics both from cultural and experimental points of view.

It is known that, in pemphigus vulgaris and in European vegetating pemphigus, cutaneous lesions along with similar lesions in the mucous membranes are found. Dejean (1925), D'Amico (1925), Villard (1925), Corrêa Meyer, and D. Mazzei have demonstrated both clinically and histologically the correlation existing between cutaneous and conjunctival lesions.

From the clinical point of view, the lesions are vesicular and appear in the form of blisters, or they are caused by the secondary loss of epithelium.

Histologically, epidermolysis, infiltration with prevalence of eosinophiles, and subepithelial sclerosis may be observed.

Gelpke, Bordley, and Cirincione have isolated a diplococcus, similar to the enterococcus, that is virulent to the rat and mouse,

* From the Instituto Adhemar de Barros. Acknowledgement is made to Dr. João Paulo Vieira for his aid in compiling data; to Mr. Augusto Estêves for the illustrations in color; to Walter Hadler for the anatomico-pathologic examinations. The microphotographs were taken at the Instituto Conde de Lara.

and capable of producing an acute conjunctival reaction in these laboratory animals.

The ocular involvement in vegetating pemphigus and pemphigus vulgaris is of the chronic type, localized exclusively, or at least predominantly, in the conjunctiva, with consequent synechias and symblepharon, so that it is commonly called conjunctival pemphigus.

Casenave's pemphigus foliaceus generally does not present mucous-membrane involvements, and this distinction is pointed out by various authors as being a helpful sign for a differential diagnosis.

After examining over 60 patients at the Serviço do Pênfigo Foliáceo of the Instituto Adhemar de Barros, Dr. Antônio Corrêa, otorhinolaryngologist, believes that buccal, pharyngeal, nasal, and auditive lesions are negative, thus confirming what has already been stated.

Ocular manifestations

The study of ocular manifestations of pemphigus foliaceus offers some difficulties because the majority of patients are bedridden, incapable of movement due to osteoporosis, malnutrition, atrophies, spontaneous dislocations, and other symptoms. Only in an organized service where there is a chance of examining patients carefully can a study of the ocular lesions be carried out. At the Instituto Adhemar de Barros, we were able to examine 240 patients during the year 1944. All of these patients were examined with the slitlamp and corneal microscope. Herein are reported the various ocular findings from the skin and adnexa to the iris and crystalline lens.

Superciliary region

The superciliary region is the site of lesions identical to those which appear in the cutaneous tegmen in general (figs. 1 and 2). Since the description of pathologic cutaneous changes comes within the scope of the dermatologist, we will point out here, as well as in the palpebral region, only those alterations that present characteristics of ophthalmic interest.

The skin presents lesions peculiar to pemphigus foliaceus; these are blisters of different sizes, exfoliations of the superficial layers of the skin, vesicles, scars and regenerating processes, atrophy of the epidermis, and so forth.

When the superciliary region is involved by cutaneous lesions the eyebrows are thinned out. This loss may be either total or partial. When the process undergoes involution, they almost always regenerate.

The superciliary sparseness is not a constant phenomenon because there are patients who go through all the stages of pemphigus foliaceus without the eyebrows being affected. Other patients may present a total loss, the aspect being identical with leprous and syphilitic manifestations.

In our examination, 5 percent of the patients showed total loss; 20 percent partial loss, and in the rest this symptom was not present.

Eyelids

In pemphigus foliaceus, the cutaneous lesions of the eyelids are no different from those observed upon any other region of the skin. Blisters, vesicles and crusts may or may not be associated with erythema. When the network of the subcutaneous palpebral tissue is infiltrated with transudations, edema is noted, although this is not common. Pain also is rare.

The alterations that may result from the cutaneous lesions are in relation to the palpebral form and motility (figs. 1 and 2). When the palpebral skin, one of the most delicate structures of the human body, is the site of blisters and exfoliatory formations, the result is a fibrosis which changes the course of the free palpebral border, giving it an oblique direction, and, upon contraction of the orbicularis, an incurvature is caused which drags the free margin backward. As a consequence of this change, we

Fig. 1 (Amêndola). Appearance of pemphigus foliaceus.

find entropion of the upper eyelid, tylosis, trichiasis and blepharophimosis.

The deviation of the eyelashes of the upper eyelid, causing continuous trumatism of the anterior corneal surface, gives rise to superficial infiltrations localized in this region, with formations of pannus, vascularized loops, and superficial keratitis, all of which cause very serious visual disturbances.

The entropion and pseudoptosis may also be a consequence of muscular palpebral atrophy, which has been verified by anatomicopathologic examinations (fig. 3). These revealed a marked atrophy of the bundles of the orbicularis muscles next to

the basal region of the eyelid, the muscular fibers being considerably diminished, irregular in size, and no longer showing their normal striae. A granulous structure of fibrillar tions will remain unchanged.

On the lower eyelid, the cutaneous lesions of pemphigus foliaceus very often cause a contraction of the palpebral tissue, giving

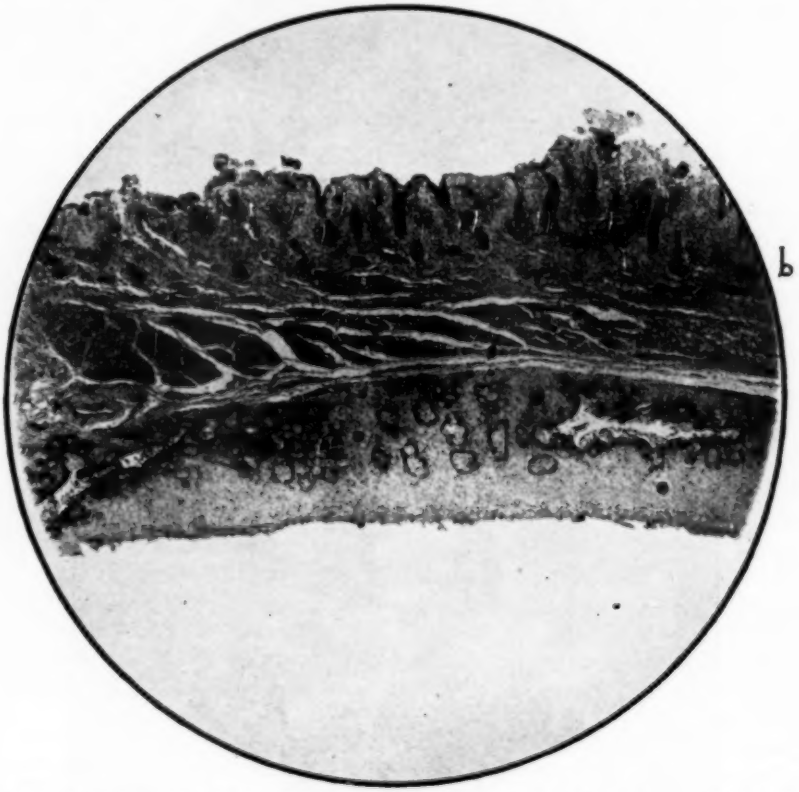

Fig. 3 (Amêndola). Section of the lid. Note the alterations caused by chronic conjunctivitis, with (b) muscular atrophy in the region nearest to the basal portion of the lids. (Magnification ×24; hematoxylin-eosin stain.)

cytoplasm may be observed. Surrounding the atrophied fibers there is a slight lymphoplasmocytic infiltration (fig. 3). These phenomena give the patient the appearance of one suffering from trachoma.

When the palpebral alterations are incipient chiefly in mild forms of pemphigus foliaceus, they have no definite characteristics and disappear in the retrogressive cases, although the plastic corneal alterarise to a slight ectropion which prevents the normal closure of the lids thus causing a slight lagophthalmos, that may disappear upon cutaneous recovery. In severe and advanced cases with muscular atrophy, already described, the lagophthalmos is likely to become permanent, thus preventing closure of the eyelids even with voluntary movements. The eyelashes may be rarified but total madarosis is very uncommon.

FIG. 2

FIG. 6

FIGS. 2 AND 6 (AMENDOLA). OCULAR ALTERATIONS THAT MAY RESULT FROM THE CUTANEOUS LESIONS IN PEMPHIGUS FOLIACEUS. (FIG. 2) THE ILLUSTRATION SHOWS RAREFACTION OF THE EYEBROWS, BLEPHAROPTOSIS, BLEPHAROPHIMOSIS, DECREASE OF THE MUSCULAR TONUS IN THE LOWER LID, ENTROPION OF THE UPPER LID, SLIGHT ECTROPION OF THE LOWER LID, PERILIMBIC VASCULAR INVASIONS, AND CORNEAL PANNUS. (FIG. 6) DESCEMETOCELE WHICH BEGAN WITH DRYNESS OF EPITHELIUM, INFILTRATION OF INTIMA, BLISTERS, FUSION OF THE ULCERS, AND DESCEMETOCELE.

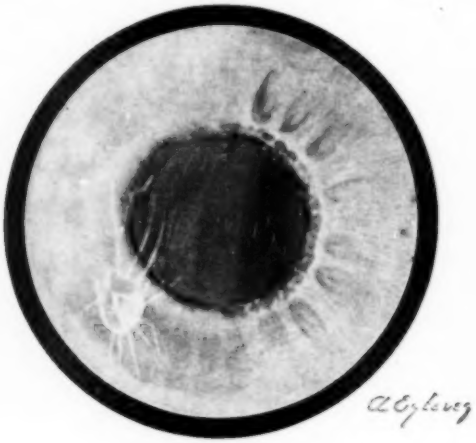

FIG. 4

FIG. 5

FIGS. 4, AND 5 (AMÊNDOLA). CORNEAL LESIONS IN PEMPHIGUS FOLIACEUS. (FIG. 4) INFERO-INTERNAL CORNEAL BLISTER. (FIG. 5) TWO BROKEN CORNEAL BLISTERS SHOWING THE RING OF DEMARCATION, SMALL DIFFUSE INFILTRATION AND DOTS BESIDE THE LARGER BROKEN BLISTER.

FIG. 8

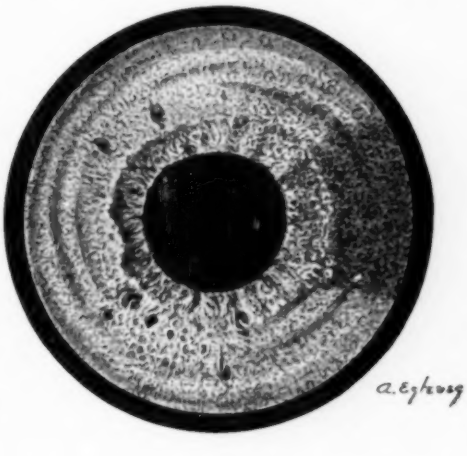

FIG. 9

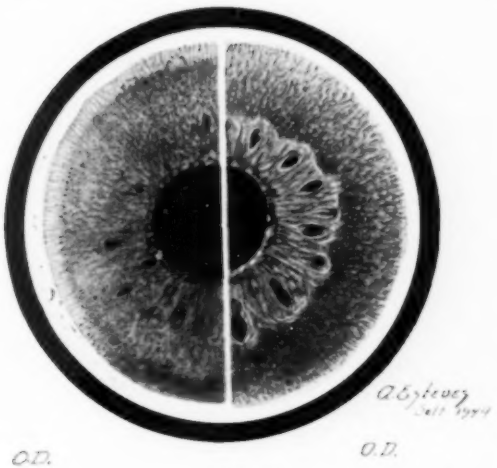

FIG. 10

FIGS. 8, 9, AND 10 (AMENDOLA). IRIDIC LESIONS IN PEMPHIGUS FOLIACEUS. (FIG. 8) IRIDIC MANIFESTATION WITH DIFFUSE PIGMENTATION, BROWNISH-RED IN COLOR AND HAVING THE APPEARANCE OF A BLOOD-STAINED SPONGE. (FIG. 9) STAGE IN TRANSITION FROM FOLIACEUS TO PIGMENTED FORM. (FIG. 10) TWO HALVES OF THE IRIS SHOWING THE EVOLUTIVE IRIDIC CHANGES BOTH HALVES HAVE THE APPEARANCE OF A BLOOD-STAINED SPONGE.

FIG. 11

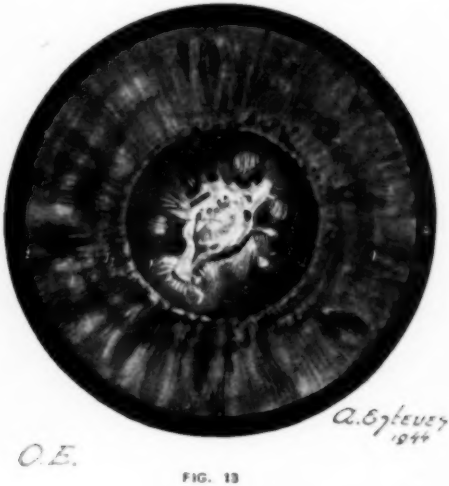

FIG. 13

FIG. 14

FIG. 15

FIGS. 11, 13, 14, AND 15 (AMENDOLA). CATARACTS IN PEMPHIGUS FOLIACEUS ASSUME VARIOUS ASPECTS. (FIG. 11) EXTENSIVE OPACITY IN THE SHAPE OF A GANGLION CELL WHICH AFFECTS THE ENTIRE THICKNESS OF THE CORTICAL LAYER. (FIG. 13) CENTRAL OPACITY CORRESPONDING TO THE ANTERIOR CORTEX OF THE LENS. (FIG. 14) CORTICAL OPACITY OF A DEPRESSED AND IRREGULAR APPEARANCE WITH FINE DOTS IN THE LOWER INTERNAL SECTOR. (FIG. 15) CORTICAL ANTERIOR CATARACT WITH AN OPAQUE DOT IN THE INFERO-EXTERNAL SECTOR. NOTE THE BROKEN CORNEAL BLISTER IN THE NASAL SECTOR OF THE CORNEA

Conjunctiva

The conjunctival mucosa in patients with pemphigus foliaceus presents alterations which reach the palpebral conjunctival mucous membrane, no noticeable changes being observed in the bulbar conjunctiva.

In the acute stage, the disease is commonly associated with an inflammatory condition, which is characterized by a congestion of the mucous membrane's catarrhal secretion, and conjunctival contraction.

The anatomicopathologic examination of the conjunctiva has shown a lymphoplasmocytic infiltration more or less diffuse, with a decreasing intensity in the deeper layers. One may observe an increased number of blood vessels, all of a capillary nature, the walls of which are formed by a single layer of endothelial cells. (fig. 3).

The bacterioscopic examination of the catarrhal secretion showed the following results: neisseria, hemophiles, streptococcus, and staphylococcus. All the cases observed showed a large number of bacteria, with intense eosinophilia in the cases stained with Giemsa.

In the retrogressive cases and mild forms, the conditions are completely different. The mucous membranes are generally normal, with the predominance of residues of the former inflammatory state. In patients who went through the acute stage without any conjunctival inflammation or catarrhal secretion, the mucous membrane is whitish and dull.

No case has been observed with formation of blisters or scars localized on the palpebral or bulbar conjunctiva. On the limbal region, in cases with corneal pannus and blisters, we observed the formation of some small extensions of vessels penetrating in the direction of the corneal lesion.

Scleroconjunctival hyperemia, rare among patients with pemphigus foliaceus, and catarrhal secretion are rather a sequel of a local microbial association and not the consequence of the lesions of pemphigus foliaceus itself.

Cornea

The corneal lesions in pemphigus foliaceus are characterized by formations of blisters, infiltration, and corneal pannus. (figs. 4 and 5). The blisters are nearly always accompanied by linear infiltrations which may be either diffused or circumscribed or in the form of an opacity upon the epithelial surface, sometimes reaching Bowman's membrane (fig. 4).

They are generally accompanied by other manifestations of broken blisters. A loss of epithelium is then noted, which may be either circular or egg-shaped, presenting in the central part a more compact zone of light gray coloring that fades toward the periphery, which is limited by a ring of demarcation (fig. 5).

A whole blister is not often observed, since the blisters undergo continuous trauma caused by the palpebral movements, which break their fragile surface, or Nickolski's phenomenon is present. This phenomenon, observed in patients with pemphigus foliaceus, takes place upon the skin and consists of a cutaneous loss of epithelium easily caused by even simple friction. There are authors who attribute the loss of epithelium to Nickolski's phenomenon even when there is no formation of blisters; therefore, this phenomenon would explain all the corneal alterations, and also the perforation and secondary complications (fig. 6).

The broken blisters, when recent, show a central turbidity of a grayish color, and regeneration begins with the clearing of the central part, although the ring of demarcation and somewhat faceted level of the central depression remain indelible, thus defining the sequelas of the process (fig. 5).

The blisters are generally localized in the middle and lower sector of the corneal surface, and have not been observed either in the upper sector or in the peripheral zone

of the cornea. Vascular neoformation in this pathologic process is rare.

The infiltrations appear in the acute phase of the pemphigus foliaceus. They are localized infiltrations, macular in form, of bands in the epithelial tissue or in islets, with limbic reaction. The infiltrative islets are of a grayish-white color with a slight elevation and occupy the most central region of the cornea, as if they were a phase

Fig. 7 (Amêndola). Section of the cornea and iris showing thickening of the epithelium with irregularity of Bowman's membrane, corneal pannus, and iridic synechia. Magnification ×93; hematoxylin-eosin stain.)

shining aspect, and light gray color, reaching from the epithelium to Bowman's membrane and retrogressing to corneal pannus in a few days.

The corneal pannus is observed chiefly in the forms which involve the eyelids, that is, in cases with a deviation of the free edge and trichiasis (fig. 5). It has the characteristics of degenerative pannus and is observed either in the form of infiltrative preceding the diffuse stage.

The anatomicopathologic examination of this pannus shows the thickening of the epithelial layer, caused by an increased number of cellular layers. In certain parts of the section (fig. 7), Bowman's membrane appears in an irregular form, with invaginations and angulations. Some of the epithelial cells are full of dark-gray pigment. The existence of a slight inflammatory lympho-

plasmocytic infiltrate may be observed with some neutrophils and rare eosinophils, forming groups at certain points where several capillary blood vessels of varied caliber may be observed, the walls of which are formed by a single layer of endothelial cells. At this point there is a small contraction of the corneal tissue.

The corneal pannus is found nearly always in the lower half of the cornea, extending to the internal or external side, and it may be distinguished from trachomatous and scrofulous pannus by its localization. One must always remember, however, that corneal pannus in pemphigus foliaceus may be accompanied by trachomatous pannus, although this finding is rare.

We have observed very often that the open blisters are accompanied by corneal pannus and, in one case, we observed a formation starting upon the pannus itself. The vascular neoformations sometimes appearing in the corneal pannus are of varied caliber, sometimes thin in the form of filaments only visible with the corneal microscope, and at other times perfectly clear, sinuous, and ramified as though they were trees, giving an impression, as in one case observed by us, that the bright red vessels, of large diameter and with very evident return circulation, were projecting from the surface of the pannus.

Frequently the liquid precorneal layer seems to be abnormal, as though it were diminished. The viscidity is altered and its aspect is slightly sticky. In two cases, biomicroscopy showed an abnormally granular aspect, in the central area of the cornea and in the subepithelial anterior layer, which could not be related to the corneal scar.

Iris

The pathologic alterations of the iris are characterized by the degenerative process (figs. 7, 8, 9, and 10). These modifications are evident upon examination with the slit-lamp and corneal microscope, although subjective symptomatology is completely absent.

In the acute forms of pemphigus foliaceus, iris alterations of a dyschromic type were observed. The normal patterns of the iris surface became confused, showing punctiform dots or miliary formations covering different sectors or generalized over the entire surface; in other cases, dense heavily pigmented nuclei or hyperchromic stains or spots were visible.

In some cases, the iris is flat, no relief being visible, or there may be small elevations, more or less pronounced, in proximity to the pupillary border (figs. 8, 9, and 10).

The isolated pigmentations or the miliary formations, of a bright red color, are generally localized in the mesoderm (figs. 8, 9, and 10) and remind one of a blood-stained sponge. We consider this aspect of a blood-stained sponge as typical of the iris in pemphigus foliaceus, and it is even more pronounced in the erythematous forms (Amêndola's sign).* In the types of foliaceus evolution changing to pigmentary and in the pigmentary types of pemphigus foliaceus, we find this spongy aspect of a darker shade, which seems to indicate the evolution of the process (fig. 9).

These degenerative lesions of the iris always retain the spongy aspect even in the cases of pemphigus foliaceus considered as cured.

There are cases in which the pigmentation is even more marked, seeming to form a covering involving the entire region around the pupillary border; in other cases, it appears as thick salient plaques. These plaques were noted in two cases only, and, therefore, we cannot state conclusively that they are true lesions of pemphigus foliaceus since they may be a dyschromia without any specific cause.

The lesions are bilateral, being more marked on one side than on the other. The

* Designation of Prof. Ivo Corrêa Meyer.

pupil always reacts to light, except in the cases in which an inflammatory condition causes iridic synechias, this being a rare finding. In an anatomicopathologic section (fig. 7) one can observe the corneal lesions with iridocorneal synechias.

Tyndallization of the aqueous and floating bodies are rarely observed. Exudation on the posterior surface of the cornea was not observed in the patients examined.

In the cases of acute pemphigus foliaceus or in those in a more or less advanced stage, we find the phenomena described, characterized by modification in pigment.

In the resistant involutive types of pemphigus foliaceus, besides the broken and cicatrized blisters, plastic changes on the iris surface are noted, showing the iridic process in the course of the disease (spongy aspect without the pigmentations).

Cataract in pemphigus foliaceus

The association of certain types of skin diseases with cataract has been studied and described since 1868 (Rothmund). Cataracts have been observed in young persons of both sexes, appearing with slight bilateral opacities, which were attributed to endocrine insufficiency, particularly to the thyroid and the gonads.

In 1934, this type of cataract, associated with the cutaneous diseases, was considered as a dermatogenic cataract (Kugelberg).

Among the cutaneous diseases in which this association was found, neurodermatitis occupies the first place, followed by scleroderma and then by the "poikiloderma atroficans vasculare," known as Rothmund's disease (a rare familial disease) and recently by chronic eczema (Duke-Elder).

The concomitance of cataract in pemphigus foliaceus was observed by us in 12 of the 240 patients we examined, that is to say, in 5 percent.

The cataracts assume different aspects, from incipient involvement with punctiform opacities on the line of the anterior suture to large opacities which may occupy the entire pupillary area, causing serious visual disturbances. They present a typical aspect, with limited edges forming a depressed central area, and assuming the most varied forms (figs. 11, 12, 13, 14, and 15).

The opacities of the crystalline lens have their origin in the cortex, are dense, and extend as far as the surface. Sometimes they become deep, covering the entire cortex, or they are diffused over the entire crystalline lens, determining a slight thickening of the posterior cortex. Radiated formations, in the form of white cords, start from the central opacity and reach the periphery of the crystalline lens.

The denser central part is nearly always found close to the lines of suture, which are then difficult to perceive because of diffusion of the opacity in the central region (figs. 11, 13, 14, and 15).

The color varies from yellowish-gray or grayish-white to yellow or green, sometimes similar to the fissure of a rock crystal. In a microscopic section (fig. 12) the following may be observed: the lenticular fibers are swollen, edematous, and vacuolated; the cellular elements have increased in volume presenting an intracellular edema and degeneration.

The degenerated fibers show spherical bodies known as Morgagni's spherules. No notable changes are observed in the epithelium, but small drops of liquid, also known as Morgagni, can be noted upon it.

In Figure 11, the central opacification and the radial cords have the aspect of a ganglion cell.

Figure 13 shows a more greenish central part, with yellowish-gray peripheral parts, assuming an ampullar aspect with central depression. In Figure 14, the oval-shaped depressed central formation, with a small upper appendage, reminds us of a vesicle of a cysticercus during the evagination of the head.

Figure 15 shows a cicatricial corneal

formation of a ruptured blister with a central crystalline opacity with radiated and depressed places on the anterior part of the cornea reminding us of the ventral surface of a Sarcoptes, with the diffusion of several remind us of a blood-stained sponge which is also a characteristic feature of iris involvement in pemphigus foliaceus.

This crystalline-lens involvement associated with pemphigus foliaceus was found by

Fig. 12 (Amèndola). Sagittal section of the lens. Note the degenerative phenomena with round, confluent vacuoles in the peripheral layer of the cortex (Morgagni's spherules). Present are the degenerative aspects of cortical cataract. (Magnification ×500; hematoxylin-eosin stain.)

opacified filaments in the anterior and posterior part of the cortex.

Laterally, in all the cases, one may observe an opacified dotting, which is clearly revealed with the slitlamp and in pathologic examination (figs. 12, 14, and 15).

Almost all the cases show alterations of the iridic surface, some with absence of crypts and folds of contraction; the pigmentation as well as the superficial aspect

us in the so-called forms of resistant or frustrate pemphigus foliaceus, in which the disease is disguised, or in patients who went through the acute cutaneous stage with vesicular blisters and even exfoliative formations, pigmentary and degenerative manifestations of the skin remaining as traces.

In the acute stage of pemphigus foliaceus, the crystalline lens may show some puncti-

form opacities that may assume a stellar form on the line of the suture. In other cases, slight modifications of refraction, only visible with the slitlamp, are seen. These modifications are so slight that sometimes it is difficult to state whether they are normal or pathologic.

The forms of cataract which involve nearly the entire pupillary area, with thickening of the central part, of grayish-white, yellow, or green, or yellowish-gray color, typical to pemphigus foliaceus, have been observed by us in cases of involutive pemphigus foliaceus in patients at the regressive stage of the disease and able to leave the hospital, or in those who work in the infirmary. There are, however, those whose visual disturbances do not allow them to perform any work for the time being.

Just as the pathogenesis of senile cataract was and still is a point of discussion among the ophthalmologists, the pathogenesis of cataract in pemphigus foliaceus is still under investigation, since neither the etiology nor the pathogenesis of pemphigus foliaceus is as yet clear.

Is it a degenerative or inflammatory process, secondary to the morbid manifestations of the iris in pemphigus, which prevents perfect nutrition of the crystalline lens?

Would the avitaminosis that plays an important part in the genesis of cataract and also of pemphigus foliaceus explain the formations of the typical opacities of the crystalline lens noted in patients suffering from "fogo selvagem"*?

Studies on the etiology of pemphigus foliaceus, being efficiently carried out by the research workers at the "Serviço do Pênfigo Foliáceo," will bring, perhaps, some light as to the genesis of the cataract which is so often observed in this insidious disease.

Rua Augusto Tolle, 68.

* See introduction.

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THE USE OF STERILE REFRIGERATED POOLED HUMAN VITREOUS IN LIVING EYES*

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In a previous contribution[1] the history of substitution of other fluids in the place of withdrawn or lost human vitreous has been outlined. This present study deals with the experimental injection into the living human eye of pooled vitreous withdrawn from human eyes. The eyes used were sent to the laboratory of the Eye-Bank for Sight Restoration, Inc., as material for use in the operation of corneal grafting. In almost every instance, the eyes were bequests to the Eye-Bank.

The vitreous of lower animals has been used previously in an attempt to provide a clear medium in human eyes for vitreous clouded by hemorrhages or following inflammatory conditions. So far as one can ascertain from the literature, none of these operations has ever been successful. Cutler[2] determined experimentally that it was possible to transfer fractions of the vitreous of one rabbit to the vitreous chamber of another of the same species. In a later paper,[3] he reported four cases in which he substituted the clear vitreous from one freshly enucleated human eye for a portion of cloudy vitreous in the eye of a living human being. He called this procedure a vitreous transplantation.

Various crystalloids have also been used as a substitute for cloudy vitreous, but the disadvantage of decreasing tension following operation has been a deterrent. The use of the patient's own cerebrospinal fluid[1, 4] has been used with success, there being no loss in tension in the eyes following operation.

During the experimental work that was undertaken to improve the technique of cerebrospinal fluid substitution for a cloudy vitreous,[5] freshly enucleated eyes were used. That portion of the vitreous which could be withdrawn from the eyes without undue suction or other trauma appeared perfectly clear.

It was then considered that perhaps the portion of vitreous which could be aspirated from eyes of this kind could be pooled and preserved until needed. If this proved to be the case, it would obviate the difficulty encountered by Cutler, who had to have his donor and his recipient patients in the hospital at the same time to be operated upon simultaneously.

It was first necessary to determine whether or not the sclera, choroid, and retina were effective barriers against the bacterial contamination of the vitreous under the conditions that these eyes are removed and transported to the Eye-Bank laboratories. The eyes are removed under aseptic conditions and placed in special sterilized glass containers which are then shipped by air, rail, or automobile from all parts of the country to the laboratories in New York City. The eyes are thereupon examined to determine their suitability for use as donor material in corneal transplantation. If the eyes are unsuitable, they are then placed in their original containers in an ordinary household refrigerator where the temperature is maintained between 32° to 50°F.

Katzin[6] has determined that the surfaces of eyes removed in the same hospital that houses this laboratory are frequently contaminated with various strains of Staphylococci and Streptococci. The eyes used for corneal transplantation and as sources for pooled vitreous come from patients dying of diseases other than ocular, and whose blood

* The expenses connected with this research were met by the Florence Ellsworth Wilson Memorial Fund Fellowship in Ophthalmology of The Eye-Bank for Sight Restoration, Inc., New York.

Kahn or Wassermann tests are negative. Where this information is not obtainable or where the eyes are enucleated because of pathologic conditions in them, the eyes are given a thorough examination by the pathological department.

Technique of vitreous collection

Equipment

The following equipment is needed:

Sterile gauze
1 discarded scalpel blade
1 straight hemostat
2 No. 18 needles
2 2-cc. syringes
1 sterile 6-cc. rubber-stoppered glass vial
1 Bunsen burner

The eye, having been removed from its glass container, is held in a piece of sterile gauze. The sclera is seared somewhere at its equator by heating the scalpel blade, which is clasped in the hemostat, in the Bunsen burner until it is cherry red. With the No.-18 needle on the syringe, the needle is plunged through the previously seared portion of the sclera until it has entered approximately 12 mm., whereupon gentle suction and slight movement of the needle point, in and out and laterally, generally yields between 1.5 and 2.25 cc. of a clear viscid portion of the vitreous. This is immediately injected into the sterile vial. As many eyes as necessary are used to fill each 6-cc. vial, which is replaced in the refrigerator until called for. Undue suction or trauma or scraping the needle point against the retina at a point opposite the puncture site will almost always result in the aspirated vitreous being contaminated with uveal pigment.

Comment

It is realized[7] that the structure of the vitreous in the living human eye is still in doubt. It is also realized that the physical properties of the vitreous are probably changed upon removal of the eye, by refrigeration under the conditions mentioned, and by the physical process of being aspirated and placed in vials. Therefore, it was felt that instead of designating the substitution of this material for cloudy vitreous as "vitreous transplantation" that it be known as "vitreous substitution" by cerebrospinal fluid, aspirated fractions of pooled human vitreous, or whatever the material might be. It was felt that this fractional portion of human vitreous would perhaps be very useful as a substitute for cloudy vitreous and as a material to be injected in cases where there was extreme hypotony following operations for retinal detachment and for vitreous loss following cataract extraction.

Determining sterility

The next step was to determine the sterility of the pooled material. After a vial was permitted to stand at room temperature for 24 hours, a portion of it was streaked out on blood-agar plates, and another portion was dropped into a stoppered test tube of broth. The broth and the agar were placed in an incubator at 37°C. for 48 hours and, if no growth resulted, the specimen was considered to be sterile.

Repeated negative results from this technique made us feel that it could be safely injected into rabbits' eyes. Six rabbits' eyes were then used to determine what, if any, reaction would ensue if for 0.5 cc. of rabbit vitreous, an equal amount of pooled human material were injected. There was in no case an unfavorable reaction after four weeks. The contents of the vitreous chambers remained clear, there was no uveitis and no loss of tone as judged by the palpating finger. Hence we felt that we were justified in using this material in selected human cases, the detailed accounts of which follow.

Report of cases

In all the cases that follow urinalysis was normal; a complete blood count was within normal limits; and a Kahn test of the blood was negative.

Case 1. Miss A. S., aged 40 years, was seen February 11, 1947, at the Manhattan Eye, Ear, and Throat Hospital, through the

courtesy of Dr. J. J. Fried, who had operated on this patient in June, 1946, for retinal detachment in the right eye. The result was excellent as far as retinal replacement was concerned, but vision in the right eye was finger counting at 4 feet. Extreme hypotony of this eye had also produced a pseudoptosis. The vitreous was clear in both eyes. Tension was: R.E., 5 mm. Hg (Schiøtz); L.E., 16 mm. Vision in the left eye was correctable to 20/40 with a −8.0D. sph. Because of the extreme hypotension in the right eye, the case was referred to this clinic, with the request that, if possible, pooled vitreous or spinal fluid be injected to increase the tone of the eye with the idea of relieving the pseudoptosis and avoiding phthisis bulbi.

Using the technique described in a previous communication,[5] 1.5 cc. of pooled vitreous was injected into the vitreous chamber. Because a No.-23 needle was used, it was thought that a purse-string suture would not be necessary, and so it was not placed in the puncture site. The postoperative course was uneventful, but the tension dropped from 38 mm. Hg (Schiøtz) to less than its preoperative level of 5 mm. It could not be recorded on the tonometer. It was felt that the loss of tension was due to the omission of the purse-string suture.

When the reaction from the operation had subsided in about three weeks time, a similar procedure was done, using the purse-string suture. Because no pooled vitreous was available, 0.5 cc. of the patient's own spinal fluid was used instead. Immediately postoperatively, the tension in the eye was 16 mm. Hg but by the time the patient left the hospital, five days later, the tension fell to 5 mm. Hg where it has remained up to the present. The pseudoptosis of which the patient complained because of cosmetic reasons was somewhat improved immediately postoperatively, but with the fall in tension came a return of the pseudoptosis.

We are at a loss to explain the fall in tension, but believe that a possible recurrence of the old detachment, too far anteriorly to be seen with the ophthalmoscope, may be the reason.

Case 2. Mr. N. B., aged 57 years, was seen through the courtesy of Dr. R. Townley Paton. The patient had had bilateral central cortical cataracts reducing the corrected vision to: R.E., 16/400; L.E., 20/200. The patient's blood sugar was normal. Tension in both eyes was 19 mm. and 22 mm. Hg (Schiøtz) on two different occasions. An intracapsular cataract extraction, combined with a total iridectomy, was done on the right eye by Dr. Paton on March 5, 1947. Convalescence was uneventful, and by March 28th the corrected vision was 20/70. On April 5th, a small anterior retinal detachment was seen running from the 5- to the 7-o'clock positions. Bed rest did nothing to help reattach the retina and when in the absence of Dr. Paton I saw the patient, the entire lower half of the retina was detached and there were many vitreous opacites.

Consultation with Dr. David H. Webster resulted in the decision to operate on the patient in an effort to reattach the retina. A diathermy puncture with Safar needles was done under pentothal anesthesia. Because of the extensive detachment, it was felt that with the release of the subretinal fluid, marked hypotony would result. Therefore, a purse-string suture was placed in the upper nasal quadrant, so that pooled vitreous might be injected immediately following the primary operation.

As was expected a large amount of subretinal fluid was lost when the Safar needles were withdrawn. The condition of the eye can best be described as mushy. Approximately 1.5 cc. of pooled vitreous was injected with a restoration of the tension to normal, as judged by pressure with a strabismus hook. With the ophthalmoscope, the retina was seen to be in place.

On May 14th the retina was still in place, but there were still fine opacities in the vitreous. The tension in both eyes was equal as judged by the palpating finger through the closed lids. On June 1st, the patient was

admitted to another hospital because of a severe conversion hysteria. Early in July the patient died of unknown causes in the same hospital. According to the patient's wife, he lost all vision in the right eye three weeks before death, but the eye was never inflamed or painful.

Case 3. Mr. G. G., aged 71 years, was seen at the clinic of the Manhattan Eye, Ear, and Throat Hospital, April 7, 1947, where he presented himself because he had heard of our experimental surgery to improve vision. At this Hospital, he had had cataract extractions in both eyes several years previous to this visit. The left eye was completely blind because of phthisis bulbi, and the vision in the right eye was reduced to light perception.

The vitreous of the right eye was so clouded with opacities that the fundus could not be clearly seen. However, the presence of retinitis proliferans was suspected because of the appearance of the fundus through the hazy vitreous. The intraocular pressure in both eyes was 22 mm. Hg (Schiøtz). Because of this condition and his age, it was explained to the patient that the results would probably be poor. It was also explained that an unknown disease of the retina might cause a further loss of vision. Under local anesthesia, using the technique described, 1.5 cc. of cloudy vitreous was aspirated and an approximately equal amount of pooled vitreous was replaced. The patient made an uneventful recovery, and it was then easy to see, because of the clearing of the central vitreous, that the loss of vision was primarily due to proliferating retinitis involving the macula. Intraocular pressure has remained at 22 mm. Hg (Schiøtz) in both eyes up to the present writing.

Case 4. Mr. A. F., aged 25 years, was seen in the clinic of the Manhattan Eye, Ear, and Throat Hospital on June 14, 1947, complaining of blurred vision in the right eye of 12 months' duration. The patient was a boxer by profession and had been fighting for approximately 10 years. A peripheral detachment of the retina was discovered running from approximately the 7- to the 10-o'clock positions temporally. There were many fine vitreous opacities. Tension in both eyes was 23 mm. Hg (Schiøtz). Immediate operation was advised, but it was several weeks before the patient's affairs could be arranged to permit his entry into the Hospital.

On admission, the entire temporal half of the retina was found to be detached. The vision of the right eye was reduced to hand movements, and that of the left eye was 20/20 with a −0.5D. sph. Tension in the right eye was reduced to 14 mm. Hg; in the left eye it remained at 23 mm.

Again it was suspected that following diathermy puncture with Safar needles, a large amount of subretinal fluid would be lost. Hence the eye was prepared for the injection of pooled vitreous in the same manner as in Case 3. As was expected, a large amount of subretinal fluid was lost with consequent severe hypotony of the eye. Approximately 0.5 cc. of pooled vitreous was injected with the restoration of the tension to approximately normal as judged by the palpating fingers through the closed lid. Immediate examination with the ophthalmoscope showed the retina to be in place.

Four weeks after the patient's discharge from the hospital, at which time the retina was in place, the original area of detachment was again found raised from its bed, and tension had dropped to 17 mm. Hg in the right eye. It remained at 23 mm. in the left eye.

In October, 1947, a scleral resection was performed in a final attempt to reattach the retina. Again the immediate result was excellent but at the last examination in January, 1948, the entire temporal half of the retina was detached, the vision was reduced to the perception of hand movements in the temporal field and the intraocular pressure remained at 17 mm. Hg (Schiøtz).

Case 5. Miss A. G., aged 66 years, was referred by Dr. R. Townley Paton, who had performed a combined iridectomy and intra-

capsular cataract extraction on the right eye on March 15, 1947. The preoperative tension was 17 mm. Hg (Schiøtz) in both eyes. A few days after the cataract extraction, the patient had a vitreous hemorrhage with complete abolition of the red fundus reflex. By April 19th, vision in the right eye had improved to 20/70, but it failed to improve further in spite of the usual treatments. A large black mass could be seen floating freely in the fluid vitreous. On June 2nd, the tension was 22 mm. Hg in both eyes. The left eye had an immature senile cataract reducing the corrected vision to 20/70. On June 6th, approximately 1.75 cc. of pooled vitreous was injected into the vitreous chamber through the peripheral cornea and the pupil after an equal amount of cloudy vitreous had been withdrawn. Of course, no purse-string suture was used, and the oblique piercing of the cornea apparently acted as an efficient water seal.

The postoperative course was stormy. Two weeks after operation, the eye was red and painful. There was a plus-2 aqueous ray seen under the slitlamp and corneal microscope. By June 30th, corrected vision of the right eye was 20/100, and the eye was clearing. The red reflex was beginning to be seen again. The patient was put on penicillin drops (1,000 units per cc.) which caused an immediate and violent conjunctival reaction. By July 8th, the eye was white and tension in both eyes was judged to be equal between palpating fingers. The red reflex had improved. On July 18th, there was an attack of iridocyclitis with a hazy cornea, normal tension, and a filmy exudate in the anterior chamber. By July 24th, it was feared that the eye was going into phthisis bulbi. On August 4th, there was no pain, the eye was white, there were no keratic precipitates, and there were no cells in the anterior chamber. On September 4th, vision in the right eye was 20/50, corrected. On September 18th, tension in the right eye was 19 mm. Hg, and in the left, 20 mm. The vision remained at 20/50.

Comment

This experiment is a further step in the exploration of the possibilities of substituting foreign substances in the vitreous chamber of living human eyes. It is the next logical step to Cutler's outstanding contribution in which he, by having two patients in adjoining operating rooms under his control, was able to substitute the clear vitreous of one freshly enucleated eye for a given amount of cloudy vitreous withdrawn from a patient's eye. Whether pooled vitreous has any superiority except in convenience over Cutler's method, or whether it is as physiologically or immunologically sound as substituting the patient's own spinal fluid for cloudy vitreous remains to be determined.

However, it has been established that the vitreous removed from enucleated eyes under aseptic conditions and refrigerated at temperatures between 32° and 50°F. can be pooled and stored until needed for indefinite periods of time without gross changes in its clarity.

It has further been established that the injection of an aspiratable fraction of human vitreous from these eyes can be injected into living human eyes with very little reaction and no interference with the clarity of vision. In addition, in cases where there are no further reasons for loss of tone in the eye, the tension remains approximately the same for at least 10 months.

Ophthalmologists now may use the aspiratable portion of the vitreous of one eye, pooled aspiratable vitreous portions of many eyes, and cerebrospinal fluid as substitutes for cloudy vitreous or vitreous lost through previous operations or injury. Which of the three substances will ultimately prove to be the best can only be determined by the work of numerous investigators. The injection of crystalloids into the vitreous chamber, while immediately successful in maintaining tone, ultimately results in hypotony because of absorption or for other reasons as yet unknown.

Conclusion

It is established that the aspiratable portion of the vitreous of enucleated human eyes may be pooled and kept indefinitely under sterile conditions with no gross change in its physical properties. If withdrawn under aseptic conditions from donor eyes, the surfaces of which may be contaminated with bacteria, it remains sterile. This pooled material may be injected into the human eye without fear of bacterial contamination. The indications for this operation are loss of tone following retinal detachment, cataract extraction, injury, or other reasons, and as a substitute for the aspiratable portion of cloudy vitreous in a patient's eye when more conservative means fail to bring about clearing after a reasonable period of time. The further use of eye banks for the collection and storage and for the distribution of pooled vitreous to qualified ophthalmologists in addition to the original function of processing usable corneal material immediately becomes apparent.

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Ophthalmic Miniature

"I dare say that you have heard eminent physicians say to a patient who comes to them with bad eyes, that they cannot cure his eyes by themselves, but that if his eyes are to be cured, his head must be treated; and then again they say that to think of curing the head alone, and not the rest of the body also, is the height of folly. And arguing in this way they apply their methods to the whole body, and try to treat and heal the whole and the part together. Did you ever observe that this is what they say?"

Plato, *Charmides.*

MYOKYMIA OF THE EYELIDS*

A SUGGESTION AS TO THERAPY: PRELIMINARY REPORT

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Myokymia is muscular fasciculation not associated with muscular atrophy or weakness and appearing most commonly in the eyelids. The contraction, irregular in rhythm, may be observed elsewhere in the body as in the calves, thighs, arms, forearms, and hands. It is likely that all of us have at some time been annoyed by this involuntary twitching. In our experience it is precipitated by overwork, excessive fatigue, and factors tending to debilitate. The patient's symptoms may be so minimal that he seeks no medical aid, particularly if the twitching occurs in the legs or shoulders. If it occurs, however, in the eyelids and continues over long periods of time, it produces a psychologic response that, by creating a vicious cycle, has a tendency to tense rather than to relax the individual. It was for this reason that a method of therapeutic control was sought.

Denny-Brown and Pennybacker[1] consider the focus of irritation to be in the nerve fibers within the muscle. We are in accord with this as a result of observing the successful control of the twitching by the use of quinine and its aggravation by the administration of prostigmin.

Quinine aggravates the muscle weakness in myasthenia gravis;[2] whereas, it is the treatment of choice in myotonia congenita. The latter is a condition of muscular hypertonicity in the face of normal deep tendon reflexes. Persistent contractions or spasms are present or else they may be easily elicited by percussion. Prostigmine aggravates the disease. The disease has been thought by some to be due to a decrease in cholinesterase activity.[3,4] Poncher and Wade,[5] however, obtained normal cholinesterase values and noted no change after the administration of quinine. Wolf[6] states that the mechanism of the action of quinine and its possible relation to acetylcholine and cholinesterase remain to be determined.

ACTION OF QUININE

Recently much work has been done on the action of quinine on normal unstriped muscle. Harvey[7] has done the most significant researches. Quinine has a weak curariform action, blocking neuromuscular transmission and leaving unimpaired the response of the muscle to direct stimulation. According to Harvey, it causes a depression of the response of the motor end-plate and the ganglion cells to nerve impulses and to acetylcholine, but does not interfere with the normal liberation of acetylcholine from the preganglionic nerve endings. He considers that the quinine effect is probably due to the presence of the tertiary nitrogen group of the quinuclidine nucleus. He further states:

1. The ability of the muscle to respond to a tetanus is diminished on account of an increase in the refractory period of the muscle fibers.

2. The excitability at the motor end-plate is lowered by quinine and the ability of a tetanus to facilitate conduction at the end-plate is weakened or abolished.

3. Eserine cannot evoke a repetitive response to a single stimulus in a muscle which has been treated with quinine.

4. Quinine abolishes the response of the muscle to acetylcholine due to the curariform action of the drug.

Oester and Maaske[7] showed similar find-

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ings. They indicated that the site of the action of quinine may be beyond the point of innervation since it occurs in the denervated muscle. They suggested that quinine either causes a block in the acetylcholine reaction with the muscle or that it causes an increased destruction of acetylcholine. Goodman and Gillman[8] offered that the locus of action was directly on the skeletal muscle, perhaps especially on the end-plate.

Cholinesterase experiment

To investigate the possible relationship between quinine and cholinesterase, determinations of the blood cholinesterase were done before and after quinine (5 gr., 4 times daily) given for three days to 11 normal individuals. The results appear in Table 1 and show that quinine in the dosage used causes no significant change in the cholinesterase level of the blood.

TABLE 1

Results in investigation of relationship between quinine and cholinesterase*

Subject	Before Quinine	After Quinine
S.D.	7.05	6.88
E.S.	5.82	5.70
A.C.	5.92	5.60
F.D.	6.56	6.03
S.T.	6.20	6.30
L.B.	5.85	5.92
B.F.	6.60	6.54
N.R.	6.28	6.62
R.L.	5.88	5.66
B.D.	6.06	6.20
A.L.	6.82	6.68

* Normal value for whole blood: 4.50 to 6.80 cc. of 0.02N NaOH to titrate acid released from 1.2M acetylcholine in 20 minutes of reaction.

Case reports

From a practical standpoint, we have been able to control the twitchings of the eyelids by the administration by mouth of quinine hydrochloride (5 gr., 3 times daily) for three days. Before its administration all reversible pathologic conditions were dealt with and all irritating factors investigated. Hearing was also roughly tested and inquiries made regarding auditory nerve affection which would be a contraindication to the use of the drug. The patient was told to stop the medication if tinnitus or visual disturbance occurred.

Fifteen cases have been treated to date. All had relief and improvement, 60 percent getting complete abolition of the twitching. In some cases, the frequency of the twitching diminished and only disappeared after longer periods of treatment. In some cases, the twitching was aggravated before treatment by sneezing and yawning. This condition was alleviated.

Case 1. A typical case is that of E. E., aged 30 years. His father had undergone an operation for chronic simple glaucoma in his only remaining good eye. The operative result was a success but the undue strain under which the son, the sole support of the family, was placed left him with a twitching of his left lower lid that had, on his first visit for treatment, lasted two months. This twitching occurred all day long at intervals of 5 to 20 minutes. No physical abnormality being observed, the patient was given quinine hydrochloride (5 gr., 3 times daily) for three days with complete relief of the symptoms. There has been no recurrence to date (five months).

That the action of quinine for muscular contractions can be of value elsewhere in the body is suggested by the case of W. W., reported through the courtesy of Dr. Otto Risch. This was a case of spasmodic contractions of the stapedius muscle markedly influenced by the administration of quinine.

Case 2. W. W., aged 67 years, was seen by Dr. Otto Risch on May 20, 1947. His chief complaint was an audible clicking sound in both ears for the past year, more marked on the left than on the right. He did not complain of any apparent loss of hearing. This noise had been continuous, causing much distress and inability to sleep. The clicking was audible to the examiner at a distance of three feet. It was not syn-

chronized with the pulse beat but occurred about 2½ times faster than the beat.

His past history revealed that he had had a bilateral antrum window operation 10 years ago. He had also had an otitis media purulenta acuta involving his left ear 15 years ago. There had been repeated inflations over a period of time without improvement.

Examination revealed that the auricles of both ears were normal. A slight exostosis was present in the right external canal. Both membranae tympani were intact, although somewhat thickened. Light reflexes were present. The ossicles were movable and under magnification there was a slight movement of the drum, synchronized with the audible sound. Both eustachian tubes were patent. The clicking disappeared for a few seconds following inflation.

Anterior rhinoscopy reveals bilateral, patent, postoperative antrum windows, slight mucoid exudate in both nasal chambers, and postoperative perforation of the septum. Transillumination of the frontal sinuses was negative for pathologic conditions. The right antrum was diminished, 2 plus. The left antrum was diminished, 4 plus.

Tonsils were small, atrophic, and imbedded; teeth, upper and lower dentures; postnasal space, essentially normal; pharynx and larynx normal.

The patient's weight was 140 pounds. Blood pressure, 195/100 mm. Hg. Pulse, 72. Urine, small trace of sugar.

An audiometric reading showed no loss of hearing by either bone or air conduction in the lower tone limits, but there was a sudden drop at #11584 in both ears.

Diagnosis. Spasmodic contraction of both stapedian muscles.

Treatment. An operation to cut both tendons of the tensor tympani muscles was advised. Before doing this, however, the patient was given quinine (5 gr., 3 times daily). The dosage was later reduced to twice daily.

Outcome. The audible clicking sound has disappeared and the patient now sleeps comfortably.

The following case is not actually a case of myokymia but it is included because it demonstrates the potentialities of quinine by illustrating the curariform action of the drug.

Case 3. L. C., aged 54 years, a white woman, suffered from hypertension, Grade II. She was referred by Dr. Matthew Shapiro for spastic entropion of both eyes. Since the patient's general condition was not sufficiently good to permit surgery, 0.5 cc. of ethyl alcohol was injected beneath the orbicularis palpebrarum in the outer third of the lower lid of each eye. This injection was preceded by an injection of 0.5 cc. of 1-percent novocaine. The patient's condition was improved but the lids continued to turn in when the eye was closed forcibly. At this stage, quinine sulphate (5 gr., twice daily) was ordered for three days. The result was dramatic in that the entropion had completely disappeared even under forced closing of the eyelids.

Discussion

Denny-Brown and Pennybacker have attempted to classify the various kinds of muscle twitchings. In addition to (1) myokymia, they discuss (2) true fibrillation, (3) spontaneous fasciculation, and (4) contraction fasciculation.

True fibrillation is a contraction of individual muscle fibers and is due to total destruction of the motor neurons. Muscles so involved are paralyzed. Langley and Kato[9] have demonstrated that all muscles whose motor nerve supply is severed will show fibrillations. The quivering is very fine and is seen only if the muscle is exposed or if it is thinly covered, as in the tongue. It is probable that this is an expression of the law of denervation as stated by Cannon.[10] The denervated effector cells are sensitized to circulating acetylcholine and respond by fibrillation.

Spontaneous fasciculation is not fibrillation since muscle bundles or fasciculi rather than individual muscle fibers are involved. Whereas fibrillation indicates a lesion in the axon, spontaneous fasciculation is an expression of motor-cell involvement. When complete destruction of the cell body occurs, fasciculation is replaced by fibrillation. This is an irritative lesion and is most frequently observed in degenerative diseases of the motor neurons; for example, amyotrophic lateral sclerosis, progressive bulbar palsy, and progressive spinal muscular atrophy. Fasciculation is readily observed clinically. The rhythm is occasionally regular, more frequently irregular. The twitchings are of very short duration and the muscles usually show atrophy.

Contraction fasciculation is only present when the muscle is contracting. It is not seen during relaxation. Denny-Brown and Pennybacker[1] and Ford[11] point out that the contraction of a normal muscle consists of a regular series of contractions of small muscle-fiber groups. These occur in an orderly sequence so that their fusion results in a smooth contraction of the entire muscle. If some of the motor neurons are lost, the series becomes discontinuous and a smooth contraction is not possible. Consequently, the contractions of the individual muscle bundles are observed.

Although the prognosis of spontaneous fasciculation is invariably fatal, the prognosis of contraction fasciculation is variable. It may be an expression of progressive neuron degeneration (amyotrophic lateral sclerosis). Ford, however, has seen it in eight cases of long standing poliomyelitis with muscular atrophy and weakness and in one case of luetic meningomyelitis with severe muscular atrophy. The progress of the disease in the latter instance had been arrested by antisyphilitic therapy seven years before. Ford is of the opinion that contraction fasciculation is commonly associated with chronic diseases of the anterior spinal gray matter.

The dramatic effect of quinine on muscular twitching has led to experiments concerned with the twitchings observed after eserine and D.F.P. instillations in the eye. This together with the effect of quinine on intraocular pressure is now under investigation.

Summary

1. Fifteen cases of myokymia of the eyelids were treated successfully by the oral administration of quinine.

2. A study of the blood before and after quinine administration shows that the effect is achieved without causing any significant change in the cholinesterase level. Therapeutic control is probably produced by the weak curariform action of the drug.

3. The possibility that quinine may offset the untoward muscular twitching observed after eserine and D.F.P. instillations is now being investigated.

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SURGICAL TREATMENT OF RETINAL DETACHMENT WITHOUT RETINAL TEAR

Prolonged Subretinal Drainage

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The retina, in order to adhere to the choroid following operation for detachment —that is, after a plastic choroiditis is produced—has to come in contact with it. This happens, when the subretinal fluid is entirely drained off, or if it is absorbed by the choroid. We know little about the absorption by the choroid. There are several good reasons to believe that this occurs. For instance, in many cases of successful operation it takes a few days before the retina reaches its normal position. Also, the ocular hypotony in detachment is due to absorption of the subretinal fluid by the normal choroidal vessels. The condition of the choroidal vessels seems to be the decisive factor in the absorption of the subretinal fluid. In many cases marked pathologic changes have occured in the choroid of eyes with detachment, "characterized by degenerative changes . . . hyaline degeneration of the choriocapillaris, sclerosis of the vessels, and marked pigmentary changes on occasion involving complete disappearance of the pigment cells" (Duke-Elder[1]). According to Arruga,[2] all retinal detachments of more than two years' duration are accompanied by complete atrophy of the choroid. Functional decline of the choroidal capillaries in the aging person could also account for the larger percentage of unsuccessful operations on elderly patients.

Removing subretinal fluid

The surgical way of removing the subretinal fluid had been in the minds of ophthalmologists long before Gonin's time. In fact, the subretinal fluid was considered the primary cause of detachment. The very first operation for retinal detachment consisted in scleral puncture, Ware,[3] 1805. The drainage was later achieved by various methods: de Wecker,[4] 1872, trephine opening over the subretinal space; with gold wire, de Wecker,[5] 1876; sclerectomy, McKeown,[6] 1877; trephination, Higgins,[7] 1879; ignipuncture, de Wecker,[8] Martin,[9] De-Luca,[10] 1881. This last procedure, however, introduced a new concept, that of circumscribed plastic choroiditis beside the drainage. Mooren[11] aspirated the subretinal fluid with a hypodermic syringe.

Even Gonin[12] advocated incision of the sclera, that is drainage, before applying the thermocautery. This latter probably produced a large enough hole for prolonged drainage. Vogt[13] did not do the preliminary incision of the sclera, but he stated that, through the puncture with the galvanocautery, sufficient fluid is drained off.

Since the abandonment of the thermo- and galvanocautery method, and introduction of the surface and perforating diathermy and the chemical methods, more attention has had to be paid to the drainage. Weve[14] used the electrocautery or the diathermy needle, when the retina was not close enough to the choroid following surface diathermy. When doing perforating diathermy and the retinal tear was far from the choroid, he used the conical electrode to drain off enough fluid.

Guist[15] perforated the choroid with a conical probe at one of several places where the sclera was trephined. Lindner[16, 48] did it on all places of scleral trephination, where there were no large choroidal vessels. Larsson[17] did 1 to 2 scleral trephinations. Safar[18] did trephination at the deepest site of the detachment or electropuncture with a larger needle electrode to reach the subretinal space. Lindner,[19] in his undermining method for a hole in the macula, ruptured the choroid at several places of scleral trephination. Later he used this method against peripheral holes as well.

Arruga[20] emphasized that adequate drainage must be obtained for a period of time, therefore he used a needle, 0.5 mm. thick, to perforate the sclera and choroid, or the galvanocautery at the end of the operation. But he[21] also said (1937) that the retina has to lie on the choroid when the operation is finished. This is also Weve's opinion.

Other ways to obtain drainage are: simple suction apparatus for withdrawal of the fluid, Blumenthal[22] (1938); galvanopuncture, and suction if necessary, Machemer[23] (1939).

In the discussion of Pischel's[24] paper on scleral excision, in which he clearly defined the four principles to be obeyed for the cure of retinal detachment, the importance of drainage was emphasized by Berens, who stated that electrolysis gives satisfactory drainage; by Thorpe, who placed one or two trephine holes in the sclera; by Gradle who used a large diathermy needle; and by McLean who produced drainage holes with the cutting current.

Stallard[25] advocates suction with a glass tube, 5 mm. in diameter and 2 mm. thick, to the sclera around the site of the diathermy puncture. In view of the vast literature of the therapy of retinal detachment, it is probable that this enumeration of methods to drain off the subretinal fluid is rather incomplete.

All these different methods of drainage act only temporarily and, in many cases, it is impossible to remove all the subretinal fluid. A scleral puncture closes immediately; it is even hard to squeeze out fluid after removal of the knife or needle following posterior sclerotomy. It is also probable that small holes of the choroid close quickly.

The search for a prolonged drainage is evident from several papers. Galezowski,[26] 1890, "passed a needle threaded with very fine gold wire through the conjunctiva, scleral wall, choroid, and, making a counter puncture, tied the ends over the conjunctiva. Infection following the gold thread, always resulted in loss of the eye" (quoted from M. Wiener). Thomson and Curtin[27] made a trephine hole in the sclera and 10 days later the subretinal fluid was aspirated; this procedure was repeated as often as necessary. This, however, in the absence of a plastic choroiditis and probably in the presence of a retinal tear, could not lead to permanent cure.

M. Wiener,[28] 1924, used half of a horsehair, 8 to 10 mm. in length, which he introduced between the choroid and retina after removing the scleral button, and after the choroid was punctured. The other half of the horsehair was held in position on the surface of the sclera by the replaced conjunctiva. Later he made two trephine openings, the horsehair was passed through one opening and out through the other.

In many cases with retinal hole, however, there is no need to drain longer, because

clinical experience has taught that, when the tear is sealed, the subretinal fluid is absorbed by the choroid, if this is not badly damaged so far as its function is concerned.

The situation is different in those cases in which the choroid does not have the capacity of absorption, or in which there is no tear, or in which no tear is visible. Then prolonged drainage, combined with measures to make the retina lie on the choroid, is desirable.

This condition exists in old, desperate cases, already operated on unsuccessfully by other standard methods. They are not too rare. Statistics show that when the cases are not selected—not only those of a few weeks' or months' duration—in 10 to 25 percent of the detachments there is no visible tear.

In Imre's[29] series they represented 9 percent. This small percentage was obtained through the aid of an artist well trained in ophthalmoscopy, who, after thorough examination of the eye by staff members, searched the fundus for hours and made a detailed drawing of it. It is generally accepted that these cases give poor surgical results, but should one refuse to operate on them?

Surgical procedures

The method advocated for the surgical treatment of such eyes is as follows:

In order to obtain drainage of longer duration from the subretinal space, a drain (fig. 1) is installed through a scleral and choroidal opening for a period of 1 to 2 weeks. The drain, 2½ mm. in length and 1½ mm. in width, is made of silver. It has a rim, 1½-mm. wide, which is perforated at four points for the introduction of sutures by which the drain is fastened to the sclera.

Draining of the subretinal space, however, is not enough. To effect a cure, the retina has to adhere to the choroid. Therefore, the first step in the operation is to perform surface diathermy. In the absence of a tear, this is done at the point where the detachment is most elevated, well behind the equator, in one quadrant or even over one third of the circumference. It is doubtful, however, whether the altered choroidal vessels are capable of producing sufficient plastic material.

Because of the loss of even a small amount of subretinal fluid through the perforating diathermy, trephination of the sclera necessary to introduce the subretinal drain would be rather difficult. This is the reason for doing surface diathermy. The place of the scleral trephination is slightly peripheral to the surface diathermy. A 1½-mm. trephine is used and the choroid is exposed.

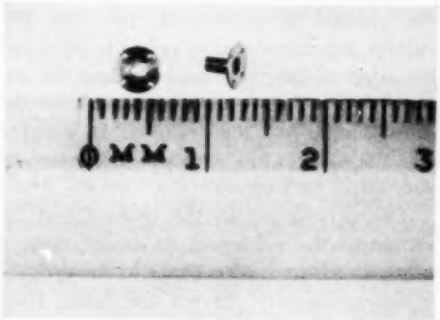

Fig. 1 (de Roetth). One subretinal drain viewed from above, the other from the side. (Magnification, ×1.7.)

The unsolved problem is, so far, how to perforate the choroid without causing hemorrhage. Simple excision of the choroid, diathermic puncture, and coagulation with the cautery applied to the choroid have been tried, as well as surface coagulation of the sclera around the opening, but no method seems to assure against hemorrhage.

The hole has to be placed far from the vortex vein and in such a way that gravity should aid drainage. In one case, it was placed at the 6-o'clock position, and the severed inferior rectus shifted with a suture to the side. When, after a week, the drain was removed, the adhesion of the muscle to

this new place was quite strong. It was not easy to put the muscle back to its original insertion. Thus, the temporary shifting of the muscle is impractical.

The nasal or temporal edge of the inferior rectus is another place for trephination, but this is just about the meridian of the vortex vein. In two cases, when the site of the trephination was the lower edge of the externus muscle, heavy hemorrhage resulted.

After the sclera is trephined and before the choroid is perforated, two 6-0 silk sutures are introduced at opposite points of the edge of the trephine hole, and the sutures are pulled through the holes of the drain rim so that the drain can be inserted and the sutures tied immediately after the choroid is perforated.

The perforation of the choroid and the escape of the subretinal fluid will cause a more or less marked collapse of the eyeball; which again may prevent the retina from reaching the choroid. There has to be a pressure difference between the preretinal and retroretinal space in order that the retina may come to lie on the choroid. There also has to be a pressure difference between the subretinal space and the outer opening of the drain, otherwise the subretinal fluid will not escape.

To increase the preretinal pressure—keep in mind these are eyes without retinal tear or at least they are undetected—air is injected into the anterior chamber through a previously made oblique canal of the cornea. The canal can be made with a discission needle before the sclera is trephined, quite obliquely, so as to prevent loss of aqueous. The injection of air into the vitreous for retinal detachment was apparently first done without encouraging results by Jensen,[30] 1892; and also by Ohm, 1911; Rohmer, 1912; Jeandelise and Baudot, 1926; Symanski, 1933; perfected and successfully used by Arruga[21] (1935) and, independently from him, by Rosengren[22] (1938).

In short, the steps of the operation are: retrobulbar anesthesia, conjunctival wound, severing of 1 or 2 muscles, surface diathermy, obliquely perforating canal in the cornea, scleral trephination, insertion of the two 6-0 silk sutures carrying the drain to the edge of the scleral fistula, perforation of the choroid, insertion of the drain and tying of its sutures, injection of air into the anterior chamber, reattaching the muscle, and closing the conjunctival wound.

Case reports

The drain operation was performed on 7 eyes of 6 patients.

Case 1. Mrs. H. A., aged 60 years, was operated on June 3, 1946. Vision had been failing in the left eye for three months. Vision was: counting fingers at 2.5 m. The retina was detached from the 3- to the 11-o'clock positions to within 2 p.d. from the disc. A hole could not be seen.

Introduction of the subretinal drain in the 5-o'clock meridian, 16 mm. from the limbus, was done after surface diathermy from the 9:15- to 11-o'clock positions. On October 8th, the retina was detached from the 5- to 10:30-o'clock positions. On October 10th surface diathermy from the 6- to 8:30-o'clock positions was done and a drain was inserted 16 mm. from the limbus in the 6:30-o'clock meridian. Air was injected into the anterior chamber. On April 11, 1947, there was a shallow, walled-off detachment from the 6- to 8-o'clock positions in the periphery. Vision, with correction, was 20/70. The same condition existed on December 12, 1947.

Case 2. Mrs. K. G., aged 76 years, had had a combined cataract extraction in the right eye, in 1934. Vision was 20/20. Hypermature cataract was present in the left eye on April 10, 1946. Vision in right eye had been blurred for two months. The lower half of retina was detached.

On April 16th, multiple diathermic punctures were made between the 1- and 3-o'clock positions where a tear was suspected. On June 21st, only the upper fifth of the retina was in place; no hole was visible. Vision was hand movements. On July 12th, perforating diathermy was done from the 10- to 11-o'clock positions, and a subretinal drain was inserted 15 mm. from the limbus in the 6:45-o'clock meridian. One and one half cc. of saline were injected into the vitreous. There was severe pain on the second postoperative day with choroidal hemorrhage.

On September 27th, organized blood was present several millimeters behind the pupil. On December 4, 1946, there was light perception at 60 cm.* The

* On August 18, 1948, the pupil and the vitreous were clear; the retina was completely reattached. There was a large choroidal scar at the site of the drain. Vision was counting fingers at 2 m.

hypermature cataract of the left eye, which on repeated occasions had light perception at 3 m. only, as well as faulty projection nasally, was removed April 25, 1947. Vision was L.E., 20/20; normal fundus.

Case 3. Mr. H. Y., aged 66 years, had an intracapsular cataract extraction of the left eye on February 15, 1944. He showed a central scotoma for red and green. Vision was 20/70. On April 12, 1946, vision of left eye had been failing for two days. A retinal detachment, with an equatorial tear, was present from the 2- to 2:30-o'clock positions.

Diathermic punctures were made from 1:30- to 3:30-o'clock positions. A flat detachment remained in the inferior temporal quadrant. On October 1st, the detachment was spreading. Superficial diathermy was done from the 3:30- to 5:30-o'clock positions, and a subretinal drain was placed in the 4:15-o'clock meridian, 15 mm. from the limbus. Air was injected into the anterior chamber. The retina became reattached with vision of 20/100 on January 15, 1948, and 20/50 on April 21, 1948.

Intracapsular cataract extraction was done on the right eye on March 9, 1946, with no loss of vitreous, although the chamber filled up with vitreous and a narrow gray vitreous band was visible across the pupil after delivery of the lens. This gray filament became adherent to the cornea. On August 12, 1946, there was a large bullous detachment in the right eye from the 2:30- to 7-o'clock positions. No retinal tear was present. Vision was: counting fingers at 1 m. The gray filament attached to the cornea was severed surgically but the detachment remained unchanged. This eye developed secondary glaucoma with a tension of 38 mm. Hg (Schiøtz), and vision of light perception only.

Case 4. Mr. P. R., aged 53 years, had an intracapsular cataract extraction of the right eye on March 12, 1946. The anterior chamber filled up with vitreous, without loss. Vision was 20/20. On June 3rd, there was ablatio retinae with a narrow horizontal tear of 2½ p.d. at the 12-o'clock position. Vision was fingers counting at 1 m.

Diathermic puncture was done from the 10:45- to 1-o'clock positions. On October 21st, all except one fourth of the retina was detached. On November 26th, a tear was suspected at the 11-o'clock position. Perforating diathermy was done from the 10:30- to 12:30-o'clock positions, and a subretinal drain was inserted in the 7:45-o'clock meridian, 13 mm. from the limbus. Air was injected into the anterior chamber. On December 10th subretinal hemorrhage occurred, and on March 10, 1947, there was complete detachment. Vision was finger counting at 30 cm.

Case 5. Mr. Y. A., aged 65 years, had lost vision in the left eye in 1940, probably due to retinal detachment. There was a complicated cataract with no light perception. The right eye became blind in October, 1945. He was first seen January 11, 1946. A large horseshoe-shaped hole was present at the 11:15-o'clock position and the retina was completely detached with several folds. Vision was: counting fingers at 30 cm.

Perforating diathermy was done from the 10:30- to 12:30-o'clock positions and ignipuncture at the 11:45-o'clock position with no improvement. Trephination and puncture of choroid was done at the 5-, 5:30-, and 6:45-o'clock positions with no change. On January 12, 1947, the upper temporal one sixth of the retina was adherent, everywhere else it was detached. Vision was: finger counting at 30 cm., only down. Surface diathermy was done from 5- to 8:45-o'clock position and a subretinal drain was inserted in the 8-o'clock meridian, 15 mm. from the limbus. Air was injected into the anterior chamber.

There was marked hemorrhage when the choroid was excised. The blood was removed by suction through the scleral trephine opening. This also occurred when the drain was removed one week later. Blood was present also in the anterior chamber. Three paracenteses were performed in the next weeks. The eye was painful and there was an iritis which lasted two months. On October 23, 1947, vision was counting fingers at 0.5 m. straight ahead. The upper one fourth of the retina was reattached. On November 11, 1947, a scleral resection, a 3-mm. wide strip from the 2:45- to 6-o'clock positions, was performed. On January 5, 1948, vision was counting fingers at 6 feet.

Case 6. Mrs. P. D., aged 52 years, had cataracts removed from both eyes in 1945. The retina was detached in the right eye. Three operations were unsuccessful.

The patient was seen for the first time on December 17, 1946, when the vision of the left eye began to fail. The lower half of the retina was detached. The peripheral portion of the fundus could not be seen because of a dense secondary cataract. This was removed on December 26, 1946. No retinal tear was visible. Vision was 20/100.

On January 17, 1947, surface diathermy was done from the 3- to the 9-o'clock positions, and the subretinal drain was introduced in the 5:15-meridian, 13 mm. from the limbus.

On March 3, 1947, vision was 20/200. On April 22nd, the lower half of the retina was detached. A scleral excision was done—a 3-mm. wide strip from the 7:30- to the 10-o'clock positions. On July 1st, there was complete flat detachment. A scleral excision was done from the 4:45- to the 7:15-o'clock positions. On November 21st, there was complete flat detachment. Vision was: counting fingers at 3 m.

Discussion

In 7 eyes of 6 persons with retinal detachment, a drain was introduced through the sclera and choroid in an attempt to secure a good drainage of longer duration. Five eyes had previously one or more un-

successful operations, only in two eyes (cases 1 and 6) was the drain operation the first for retinal detachment.

Beside introduction of the drain, surface diathermy was done in at least one quadrant, and air was injected in the anterior chamber, (in one case saline in the vitreous) to increase the preretinal pressure. The drain was removed on the 7th to the 14th day. When left in for 14 days, it was covered with dense connective tissue which made its removal difficult. I feel that the drain should be left in for a period of 4 to 5 days.

Subretinal hemorrhage was noted in three cases (2, 4, 5). In Case 5, hyphemia appeared a few days after the operation. The patient must have had a retinal tear through which the blood came forward. The preretinal membrane of connective tissue in Case 2 calls for the same explanation.

Only in one case (5) have several posterior synechias formed. This was the case in which heavy subretinal hemorrhage found its way into the anterior chamber. In one case the eye was painful for three weeks. There was no damage attributable to the operation in six eyes. Only one eye showed preretinal connective tissue, undoubtedly a result of the severe hemorrhage suffered during the operation.

The danger of sympathetic ophthalmia could be held against this operation, because the uvea is traumatized, a foreign body is left in contact with the uvea, and the eye is kept soft by means of the drain for a few days. However, this danger should be regarded as quite remote, probably not greater than in any transscleral operation for detached retina, for the following reasons:

1. Injuries to the choroid are less dangerous then those to the ciliary body. To quote A. Peters[33]: "Injuries of the cornea, just as those of the equatorial region, have long been considered less dangerous than the perforating injuries of the ciliary region, as is also manifest following surgical procedures."

2. The danger of sympathetic ophthalmia is not due to the intraocular foreign body but to the specific uveitis. In this respect the statistics of Wilder[34] are highly interesting. The article, "Intraocular foreign bodies in soldiers," is a report on 731 eyes which were removed following perforating injuries, and in which one or more intraocular foreign bodies were found. Only five of these eyes caused sympathetic ophthalmia. This started 1 week, 1½, 2, 3 months, and 36 years respectively following the injury. However, the time elapsing from the injury to the enucleation of the 731 eyes varied greatly. It is possible that if some of those eyes had not been enucleated a larger number would have caused sympathetic ophthalmia.

3. The operation is performed under aseptic conditions.

4. The drain is removed after several days.

But however remote, the possibility of sympathetic ophthalmia after such an operation has to be kept in mind.

Only in 3 (cases 1, 2, and 3) out of 7 eyes has the retina reattached. This poor result should be judged in the light of several factors all contributing to a poor prognosis. These were: (1) Advanced age of the patients: youngest 52 years, oldest 76 years, average 62 years. It is known that the prognosis is definitely worse in persons past the age of 50 years. (2) Aphakia in five eyes. (3) Bilateral detachment in three cases. I[35] reported 33 cases of bilateral detachment. The second eye was operated on in 31 cases, and only in 12 was full reattachment obtained. (4) Previous operation for detachment in five cases. (5) Duration of the detachment when drain operation was performed was 1½ to 15 months, the average 6 months. This factor alone cuts down the chance of recovery to 30 to 40 percent.

On two eyes scleral excision (cases 5 and 6) was performed several months after the drain operation. The vision improved from

counting fingers at 1 foot to counting at 6 feet in one eye (case 5). In the other case (6), there was gradual deterioration.

Function of choroid

The normal choroid is expected to have a double function following detachment operation. It has to absorb the remaining subretinal fluid and produce fibrin to attach the retina to its place. There is clinical evidence that the diseased and the senile choroid is not fully capable of these functions. The first function can be greatly aided by the subretinal drain and by increasing the tension in the preretinal space. A substitution for the second function needs another approach.

This could be done by a purposely produced subretinal hemorrhage as carried out by Guist[36] in his newest operation on 18 eyes with detached retina. He introduced the Graefe knife into the eye through the sclera opposite the site of the detachment, then through the detached retina to the choroid, which was scratched with the tip of the knife to produce subretinal hemorrhage.

It is known that in old cases of retinal detachment the retina is shrunken. In such a case scleral excision is indicated. This original idea of Mueller,[37] 1909, was used by Blaskovics,[38] Holth,[39] 1911, revived and modified by Lindner,[40] 1933, and was introduced in this country by Pischel,[41] and successfully performed by others (Borley,[42] Vail,[43] Bogart[44]).

It will take much study and observation to decide clinically which cases of old, unsuccessfully treated retinal detachment, with no retinal tear, respond to prolonged subretinal drainage, subretinal glue, or scleral resection.

Summary

In retinal detachment not responding to the routine surgical methods and/or when no hole could be found, a subretinal drain was introduced through the sclera and choroid to drain off the subretinal space for several days. The reattachment is aided by surface diathermy and by injection of air into the anterior chamber. Three out of seven eyes with poor prognosis were cured.

Old National Bank Building (8).

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Ophthalmic Miniature

But, when the tears are abundant and hot, the pus scanty, the swelling great, and all of this involving only one eye, it means a long, although harmless disease. This kind of eye inflammation progresses painlessly, scarcely heals before the twentieth day, generally it lasts two months. (? keratoconjunctivitis. Hirschberg).

Aulus Cornelius Celsus. (25 A.D.).

SURGICAL TREATMENT OF RETINAL DETACHMENT*

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Our conceptions regarding the treatment of retinal separation are based upon those types which are capable of surgical intervention with reasonable expectation of cure. These embrace the so-called idiopathic cases, appearing in myopia or senility, or disinsertion of the ora serrata such as can be found in cases of hyperopia or emmetropia in young persons. A majority of the traumatic cases may also be included, as well as a certain number of cases following retinal phlebitis. Thus, we are not considering those produced by fibrous retractions of the vitreous, which at present are not operable, nor those separations following choroidal or retinal exudates, which may be alleviated by therapeutic means.

FUNDUS EXAMINATIONS

By surgical treatment we refer exclusively to diathermy, which in our experience is applicable with benefit in the majority of cases.

Ophthalmoscopic examinations must include the far periphery, even in those cases rendered difficult by partial clouding of the media. The examination should preferably be by the indirect method which allows the observer to see the fundus periphery, using, if necessary, such intense sources of illumination as a movie projector or photographic bulb.

The success of operations for retinal detachment depends on the exactness of the fundus examinations, not only before but during the actual operation. The surgical skill demanded is not great.

Detailed fundus examination preparatory to surgery must be repeated during the operative procedure. This allows us to correct immediately any error of localization or defective penetration by the diathermy. In order to effect surgical cure, it is necessary that the zone of coagulation be at the same level of the tears, and the retinal lesions must be encircled by the cordon of diathermic inflammation.

The technique of diathermic application is aided, by limiting as much as possible the resulting chorioretinal reaction, by using the weakest current which will produce the required coagulation.

In order that the results of diathermy be curative, each case must be studied in the greatest detail so that no retinal tears will remain undetected. Then, prior to operation, these lesions must be projected with the greatest care upon the scleral wall.

SEARCH FOR TEARS

The localization, extent, and prominence of the lesions must be determined. The loss of retinal sensitivity will supply useful preliminary information as to the probable localization. A blisterlike detachment of the superior quadrant may have the tear either in the bulge or at one of its edges. If the detachment is in the shape of an inferior bulge, or even more if there should be two inferior folds, we should immediately suspect that the lesion did not originate in that area but that the exudate gravitated downward from a superior area.

Cases of double inferior folds should be examined with especial care in the upper quadrants, as there we may find a flat detachment which appears like an area of retinal edema (disappearance of choroidal markings and a darkened discoloration of the retinal vessels). We are likely to find the actual tear in this vicinity.

* Presented at the III Pan-American Congress of Ophthalmology, Havana, Cuba, January, 1948.

In flat inferior detachments, the tears are always in the inferior quadrants. When confronted by a flat inferior-external detachment, in which we are unable to find any tears, it is probably a disinsertion. When the eye is rotated strongly downward and outward, the observer can detect in the extreme periphery a short arc of demarcation which outlines the disinsertion of the ora serrata.

In a flat detachment of the superior quadrants, a rather rare condition, we encounter a small fissure or opening of the superior retina which, on account of its reduced size, has allowed a small quantity of fluid to seep into the subretinal space.

Rules for outlining tears are not infallible. For example, they are liable to fail in those cases of inferior tears which allow the separated retina to form large inferior billows, thus violating the rule that inferior detachments are flat.

The location and prominence of the detachment gives the clue as to which quadrant we should search in order to find the tear. From the work of Gonin, which has since been confirmed by those who have studied the question, we have learned in which portions of the fundus tears appear with greater frequency. They are usually found in the vicinity of the equator.

By this prior knowledge of the probable location, we can direct our search to those portions of the fundus which experience has shown are most apt to be affected.

After a search of these usual areas, the remainder of the fundus must be carefully examined. As already indicated the lesion is most likely to be in the vicinity of the equator, but the macula and adjacent portions must not be overlooked.

Localization of the tears

It is most convenient to mark the location of the tears on a chart of the fundus. As the examination progresses, the approximate extension of the detached area is mapped out together with the most salient features of the fundus, such as the path of vessels adjacent to the tears, areas of cystic degeneration, patches of chorioretinitis, hemorrhagic retinitis, and so forth. The function of the fundus sketch is to show the meridian of the eye in which the tear is located and to measure, in disc diameters the distance from the ora serrata. This localization of the meridian is most important. It is our custom to employ the method of Gonin. Thus, localization is fixed by noting the reflection that the ophthalmoscopic light produces on the sclera at the exact moment the tear is seen in the center of the pupil. Uniting this reflection with an imaginary line through the center of the cornea fixes the meridian of the tear, which is then marked on the limbus with Chinese ink or gentian violet.

Preoperative treatment

Preoperative rest is essential. The patient should remain in bed with both eyes bandaged. In some cases total reattachments have been known to occur; in others there will be a marked flattening of the retinal folds. In the majority of cases, however, no effect whatever will be produced.

Some authors favor waiting for spontaneous reattachment, hoping also that the superior folds will flatten out. This hope does not appear justified, since the detachment is liable to extend and involve the macular region. In some cases, the detachment gravitates downward, leaving the superior folds of the retina unchanged.

We do not favor more than a week of waiting, for any spontaneous reattachment will take place in that interval. Furthermore, due to the formation of macular degenerative lesions which decrease or nullify the vision subsequently attained, a too long waiting period increases the danger of the operative attempt. (This is especially true in cases of that macular degeneration described by Gradle.)

The binocular bandage itself is not free from the possibility of harm. It has produced an iridocyclitis of such severity as to render the operative procedure impossible, or at least to enhance its dangers. This menace of iridocyclitis after bandaging, or even spontaneously, is especially likely to occur in those showing marked hypotonia or a beginning uveitis that is detectable with the corneal microscope. In this type of patient it is preferable to employ simple rest and simple ocular occlusion for a few days, without a compression bandage. We believe the compression bandage is permissible only if it is changed daily, discarding it entirely at the first untoward symptom.

Those patients who do not react favorably to the binocular bandage afford valuable retinal data. It indicates that the membrane is being pulled toward the center of the eye by a force sufficiently strong to prevent its reapplication. When this is determined, it is necessary to apply diathermy more strongly, penetrating more deeply than usual, in the hope that an area of adhesion between the chorioretina and sclera can be produced, which will successfully oppose the centrifugal forces that tend to separate the retina from the ocular wall.

Operative treatment

Operative treatment can be divided into two phases: (1) The presentation of the operative field, and (2) the completion of the area of sclero-chorioretinal coagulation in sufficient area to enclose the retinal tears.

The presentation of the field is not in itself difficult, irrespective of the area of the globe involved. Liberal incisions are made in the conjunctiva in half or three quarters of its circumference, followed by full retraction of Tenon's capsule. The globe is pulled forward by traction hooks beneath the recti. Care must be taken that the dissection of the superior portions of the conjunctiva does not bring about a partial ptosis.

With the exception of the externus, we do not believe the detachment of any muscles to be necessary. The coagulation can be conveniently executed when they are simply pulled aside.

The diathermic application begins with the coagulation of a sufficient area on the surface to include the location of the tears. This can be determined by transillumination, according to the method of Weve or the techniques of Strampelli or Amerabar.

In the preoperative localization, we are guided by the transillumination method of Weve, which produces an inverted image. Upon the meridian of the tear that has already been determined and marked at the limbus, we use a scale to measure the distance back to the tear (the distance of the tear minus the ora serrata, plus 8 mm., the approximate thickness of the ciliary body). We mark the determined point on the sclera with Chinese ink. This point will be the center of the coagulated area.

We insist that all methods of localization are merely approximate. The only certain thing is the diathermy. Once the site of the episcleral diathermy has been determined, we make one central application sufficient to produce a "button" of coagulation in the fundus. This will be visible with the ophthalmoscope. Its distance is measured from the tear and any necessary corrections are made.

It is necessary to bear in mind that the desired intensity of coagulation should not be exceeded. Unnecessary effects on the retina and vitreous can thus be avoided.

The depth of the application depends upon the amperage, the diameter of the electrode, and the duration of its application. We do not recommend more than 50 ma., although as much as 100 ma. have been used. In judging the required dosage, more attention should be given to the effects on the retina and choroid than the actual amount of current used. When operating upon a moist field, it is necessary to augment the current considerably, since so much

of the effect is dissipated by the moisture.

For superficial effects the electrode should be 1 mm. in diameter. Those of larger size produce a violent choroidal reaction. This may be of little consequence or even of some utility in the anterior portions of the fundus or when in the vicinity of the equator. But when approaching the posterior pole this excessive effect can be troublesome.

In order to produce its optimum effect, the diathermy should be upon a dry sclera and on a globe that is not too hypotonic. It is also advisable to coagulate superficially those areas of the fundus in which are found advanced cystic degenerations, especially when situated in the vicinity of the tears. By enlarging it in the required direction, the intervention can then be extended to include the tear.

After the surface diathermy has been completed, we evacuate the subretinal fluid at the center of the involved area by means of a heavy diathermic needle whose conical tip measures 0.5 mm. at its widest portion. This has the advantage of penetrating the sclera layer by layer, not by mechanical action, but entirely by coagulation. We introduce the needle very slowly, stopping the coagulation when the subretinal fluid appears at the puncture point. As the retina is elevated at the site of the tear, this membrane is not penetrated.

In flat detachments, this needle puncture carries some risk because it can actually penetrate the membrane, with resultant radiating folds at the coagulated area. In these cases we prefer to evacuate the fluid with the shortest types of the Weve or Vogt needles.

Once the subretinal fluid has started to flow, total evacuation should be patiently awaited, at the same time making gentle pressure upon the globe until the opening no longer drains. At that moment the retina has replaced itself upon the scleral wall. If necessary, it is possible to use an aspirating pipette, after the method of Weve.

We believe it is advisable to wait until the entire fluid has been eliminated before proceeding with the operation. One should not be concerned by the marked collapse of the globe following this emptying of large billow detachments. Although this escape of inflammatory exudate seems at times to be alarming, it is essential to the success of the subsequent operation. If we then inspect the fundus, we will frequently have the satisfaction of seeing the retina completely replaced.

Large orifices for evacuation have the advantage that they will not be occluded in the first few days following operation, thus allowing whatever remains of the subretinal fluid to escape, as well as any exudate from the coagulated choroid (Gradle).

The larger evacuating cone also has the advantage as a localizer. Due to its size, it is readily seen in the fundus after the retina has reapplied itself to the fundus wall. At that time the location of the retinal tear in relation to the scleral wall is more exactly determined than when it is projecting inward upon a retinal fold. Then, remembering the position of the puncture with respect to the tear, we widen the area of diathermy application sufficiently to include the outer limits of the retinal opening.

This enlargement and reënforcement of the retinal plaque provides the necessary depth by which it advances to assure inclusion of the retina in the zone of coagulation. It must not be forgotten that the retina is at this time in contact with the scleral wall and so can be reached by a shorter puncture. The idea is to provide an intense coagulation of the choroid through the sclera, including the retina, but without penetrating the latter. If you should happen to wound a large choroidal vessel, the hemorrhage will be subretinal, which is much less serious than when into the vitreous.

One of the best electrodes to produce transscleral coagulation is that of Pischel. It consists of a metallic knob, one millimeter

in diameter, from the center of which projects a metallic needle 0.5 to 0.75 mm. in diameter. Points of coagulation are made with this electrode about 3 mm. apart and sufficient to encircle the detachment completely. It is only necessary that a few of the intrascleral portions be visible, ophthalmoscopically, to locate the operative field.

In those cases where the reapplied retina has shrunk to the level of a flat detachment, the intrascleral coagulation will be visible from the first, thus serving for a perfect localization. Where the retina is attached to the area of the tear, and at the same time there are folds remaining at a distance, an evacuating puncture with the larger needle will be necessary before the folds become flattened to the level of the sclera.

In some cases, the evacuating puncture, although liberating a large quantity of fluid, does not result in a reapplication of the retina to its base. This is due to the retina being drawn toward the center of the globe by mechanical traction. Here it is necessary to attach the retina to the ocular wall by means of the larger needles of Vogt or Weve, the electrodes of Safar, or the small needles of Pischel. Both the electrodes of Safar and the Pischel needles must be in position prior to the puncture, as once this is done there follows a marked hypotonia which makes the subsequent coagulation very difficult. In many cases, we have treated these cases of resistant blisterlike detachments with our large conical needle. When one or two of these punctures are made penetrating the interior 2 or 3 mm., there is produced an intense coagulation of the chorioretinal membranes sufficient to produce the anchorage we desire.

Varieties of detachment

Thus far we have referred to the typical cases of detachment. Three varieties need to be described: (1) Detachment or disinsertion of the retina at the ora serrata; (2) those due to a hole at the macula; (3) aphakic detachments.

In disinsertion, the employment of a diathermic anchorage of the membranes should be made, not at the border of the disinsertion but in the healthy pars plana of the retina, 1 or 2 disc diameters posterior to the border. Due to the smaller degree of danger in this peripheral zone, larger electrodes and intense diathermy can be employed. Prior evacuating punctures can be done and, if necessary, some of the intrascleral applications can be allowed to penetrate.

When operating in the vicinity of the macula it is not necessary to bring about such intense and confluent coagulation that this zone of highly specialized function will be jeopardized. Four or five fine intrascleral punctures placed in a circle around the macula, or as near as possible, correct the detachment at least anatomically in the majority of instances.

Aphakic detachments constitute a large class, and the results of diathermy are not constant. We believe that, in these cases, the vitreous has a marked mobility due to the absence of the lens. Thus detachments readily follow chorioretinal adhesions produced by diathermy before the union is sufficiently permanent. It is also possible that the vitreous tends to retract excessively following coagulation of the surface. On this account, some authors prefer the Lindner chemical cauterization in all cases of aphakia.

However, in these cases we have attempted a different approach. Suspecting the effect of the diathermy to have been insufficient, we endeavored to bring about a firmer adherence by mechanical means.

The usual superficial diathermy coagulation is produced, then in its center there is made a small incision with a cataract knife, sufficient to reach, but not to perforate, the choroid. A fine silk suture is passed through both lips of the scleral incision, endeavoring

to include the deep layers. Before the subretinal liquid is evacuated by the diathermy needle through the scleral incision, the suture is tied so that it remains in contact with the choroid. This procedure has been successful in three cases but, due to the limited number, we have not dared to attempt it other then experimentally. Our statistics for the last two years show a recovery in 82 percent. We believe these results can be improved by a further accumulation of cases.

At times it is necessary to attempt to relieve severe cases, in which multiple large tears are present, or to attempt to operate upon eyes without sufficient tension or with indications of coincident uveitis. Our rule is never to refuse these patients. At times a case that seems hopeless responds surprisingly well.

It is advisable to conclude by saying that faith and optimism are indispensable in the armamentarium of the ophthalmologist who attempts to treat detachments. One should not become discouraged if an operation fails, but look for the cause of the failure or relapse, and correct it by operating again. At times 3 or 4 operations are required. Since, in the absence of operative intervention, vision will go down to hopeless blindness, one should operate however poor seem the prospects for success.

Marcoleta 485.

Discussion of Professor Verdaguer's Paper

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May I at this time express my thanks to Professor Verdaguer for extending to me the honor of discussing his interesting and excellent paper. I am certain that all of us have learned much, and have had new ideas presented to us which will stimulate much thought. I would like to reëmphasize several points mentioned by Professor Verdaguer, and to discuss some other features of this subject.

I agree completely with the importance of an accurate and extensive fundus examination before the operation. At this time the exact location of all tears should be noted, so that the corresponding area of the sclera can be localized at the time of operation by mathematical means if, due to a hazy cornea or lens opacities, direct ophthalmoscopic localization is not possible.

Direct ophthalmoscopic localization is of course the best and most accurate. For this we have found the Arruga retractor absolutely necessary. It retracts Tenon's capsule and the conjunctiva from the sclera so that the spot of light from the ophthalmoscope can be seen shining through the sclera. This point can then be marked on the sclera with a needle dipped in gentian-violet solution.

I agree heartily that the diathermy applications should be limited as much as possible to the region of the tear, but they should also surround areas of cystic degeneration of the retina, to prevent, as Professor Verdaguer has pointed out, the possibility of recurrences.

Another point, which deserves reëmphasis, is that in oral disinsertions one should go far back of the edge of the tear. Failure to do so is the cause of failure in these otherwise very favorable cases.

The only point in which I disagree with Professor Verdaguer is that I think it usually advisable to tenotomize a muscle, as this improves exposure of the sclera tremendously and very rarely causes troublesome postoperative heterophoria.

Diathermy technique

In the past, there has been much discussion over the value of surface diathermy compared to perforating diathermy. I believe both should be used in an operation but in two different ways.

First, plain surface diathermy should not be used but should be modified to be partially penetrating diathermy. For this, an electrode with a fine one-half millimeter point protruding from the flat surface should be used. This fine point does not perforate the normal sclera, but does lead the diathermy current into the deeper layers of the sclera and thus into the choroid. In this way we send most of the current into the choroid where we wish to obtain the coagulation and do not damage the superficial scleral layers too much.

The perforating diathermy punctures should be used just around the retinal tear for two reasons. In the first place this provides for drainage of the subretinal fluid. If 8 to 12 fine punctures are made here, it allows the subretinal fluid to escape through many fine openings. The subretinal fluid thus drains out slowly as through a sieve, allowing the retina to settle back slowly, unfolding itself gradually and smoothly. If a single large trephine opening is made for this drainage, the sudden escape of the subretinal fluid can sweep the retina into this hole causing bad traction folds. This is prevented by using many fine diathermy punctures as just mentioned.

In the second place the healing of a wound which has perforated the sclera produces the strongest possible scar. Here the episcleral tissue grows down through the puncture wound, no matter how small, and reaches the choroid where it spreads out, binding the retina and choroid tightly together and holding them to the sclera. This kind of a scar, in the region of the retinal tear, helps a great deal to seal the tear and cure the retinal detachment.

Differential diagnosis

Another important part of the treatment of retinal detachments is the differential diagnosis between simple detachments of the retina and detachments of the retina caused by sarcoma of the choroid.

When the sarcoma is large, filling one quarter or more of the fundus, the differential diagnosis is easy. And in such cases transilluminatiou casts such a black shadow that the differential diagnosis is easy to make.

This is not so in early cases when the retina is elevated over only a small area, 3 to 4 disc diameters large. Here one needs all the assistance possible to make correct diagnosis. I would like to mention several important points which give definite help in such cases.

The topographic distribution of the elevation of the detached retina is important. In simple detachments the bulla bulges in accordance with the way fluid would gravitate within a membrane.

In sarcoma, the elevation of the retina may be quite different. The bulla may extend in from the side which is unusual. The bulla may show an overhanging edge at its upper border which cannot possibly be present in a simple detachment. This point alone is almost pathognomonic of a sarcoma.

For transillumination it is necessary to have a very small transilluminator that can be easily passed far back into the retrotarsal fold. Usually indirect transillumination through the sclera is done. I believe this to be very difficult to do properly, and it is very uncertain and disappointing in early cases.

If the sarcoma fills half the vitreous cavity, the differential diagnosis is so easy it can usually be made without the aid of the transillumination. In such cases indirect transscleral transillumination shows a very definite shadow. But this is not the case with smaller tumors or even those 8 to 10 mm.

large. Here, often the light coming through the pupil is unimpaired even when the transilluminator is directly behind the tumor.

Therefore, I feel that the old accepted way of using transillumination is wrong. The way it should be done in doubtful cases is as direct transscleral transillumination. Here the observer looks through the pupil from very close to the eye and tries to see details of the fundus as the light of the transilluminator is passed behind the globe.

It is sometimes helpful to use the ophthalmoscope even without its light for this purpose. When the eye is examined in this manner, frequently the blood vessels can be seen quite well, and, in the region of the suspected tumor, even in cases of small tumors, a definite shadow can often be seen against the lighter background of the remaining detached retina.

I believe the most important single aid in making the differential diagnosis is the direct examination of the elevated retina by focal illumination from in front. This is done with the slitlamp, using the flat Koeppe contact glass and observing with the corneal microscope. In examining the elevated retina in this way, one can very easily and positively determine whether the elevated retina is translucent or not.

When a simple detachment of the retina is viewed this way, the retina is obviously translucent; and the light can be seen to penetrate through it and through the fluid behind it.

On the other hand, the appearance of a detached retina with a tumor beneath it is very characteristic when examined in this manner. There is a brownish discoloration of the retina, and the space immediately behind the retinal surface can be seen to be solid. It does not transmit light at all. Furthermore, the retina can be seen to be immobile, not even quivering on movements of the eye.

The most important point, however, is that the retina and subretinal space are not translucent. In a simple detachment, the retina is obviously translucent. If there is no translucency present, a sarcoma is present. This is the most important and helpful diagnostic point of all.

490 Post Street (2).

Ophthalmic Miniature

Hegesistratius had a suppuration near the eye, a suppuration formed towards the last tooth; immediately complete cure of the eye, thick matter came from the nostrils, little fragments of flesh were detached from the gums. In his case it seemed certain that a suppuration of the third tooth would occur, then that it would be averted; but all at once the jaw and the eyes became swollen.

Works of Hippocrates,
4th Century, B.C.

KERATOPLASTY*

I. A Preliminary Report on Development of Instruments

Otis S. Lee, Jr., M.D., and Lee Allen
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Development of various techniques for keratoplasty by ophthalmic surgeons, dating from von Hippel's[1] method with the simple trephine 60 years ago, has resulted in the conclusion that the best results are obtained only when the following three requirements are met.

1. Firm and adequate fixation of the donor's graft to the recipient's corneal bed.
2. Exact apposition of edges of graft to corneal bed.
3. Adequate protection for the lens and iris from the cutting instrument.

Firm and adequate fixation

The first requirement has been fulfilled successfully with the use of sutures to hold the graft in place as described and practiced by Thomas,[2] Castroviejo,[3] and others.

Exact apposition

The second criterion has not been met as satisfactorily. The ideal procedure would be to cut a disc completely from the recipient's cornea using only a trephine and to replace it with a circular graft from a donor's cornea using the same instrument. If performed correctly, there should be an exact fit between the graft and the corneal bed.

It is possible to excise completely a corneal disc from the donor eye with the trephine alone using the iris-lens diaphragm for support. However, this method obviously cannot be used in the recipient eye because of injury to the lens.

On the other hand, an unsupported cornea does not offer the proper resistance in order to sever completely the posterior layers with a trephine. Usually the excision must be completed with specially designed scissors.

Castroviejo[3] attempted to avoid this latter procedure by designing several ingenious instruments but they were uniformly unsuccessful. It was because of his failure to cut a corneal disc without recourse to scissors that he was prompted to confine his technique to the use of the square or rectangular graft since he claimed, and rightly so, that with scissors it is easier to make a smooth straight cut than a smooth curved one.

Green[4] and, more recently, Katzin[5] announced that with a trephine blade mounted on an automatic trephine a corneal disc could be removed completely in a significant percentage of cases. However, not infrequently, the section must be completed with scissors.

It is obvious that if scissors were to be used, whether the shape of the graft be round or square, it would require extensive practice even by a skilled ophthalmic surgeon to make the graft fit the corneal bed exactly. Thus, the chances are against, rather than for, an exact fit in a majority of cases.

Weiner-Alvis[6] and Tai[7] designed punches to remove corneal discs. The instruments are large and awkward for delicate manipulation. There is danger of damage to the lens from the thick portion of the instrument which enters the anterior chamber. Furthermore, the corneal tissue is excised by a crushing rather than a cutting action.

* From the Department of Ophthalmology, College of Medicine, State University of Iowa. This study was conducted under a grant-in-aid from the Los Angeles Research Study Club, Los Angeles, California.

Protection of lens

To satisfy the third requirement, that is the protection of the lens, some surgeons relied on the iris to cushion the cutting edge of the instrument. Others relied on their skill alone to protect the lens.

Filatov[9] was the first to devise a specific method of protection of the iris and lens. He passed an ivory or celluloid spatula through the anterior chamber which separated the cornea from iris and lens. A trephine was then used to cut through the cornea and against the spatula. However, with this technique the introduction of the spatula is a difficult and hazardous procedure and may cause injury to the iris and lens. This may defeat the very purpose for which it was designed.

Filatov has since introduced what he has named the hermetically sealed trephine, or F.M.3, which cuts through the cornea and yet does not permit the anterior chamber to collapse as long as the trephine is kept against the cornea. The concept and design of the instrument is excellent. It does not, however, always excise the corneal disc in toto and scissors sometimes must be used to complete the section. Green and Katzin have designed similar blades mounted on an automatic trephine and they have obtained approximately the same results.

The use of scissors to cut a disc or a square of cornea is not without danger to the lens. The procedure properly performed requires considerable skill and much preliminary practice on animals, thus barring and discouraging many ophthalmic surgeons from performing the operation.

The present investigation was undertaken in an attempt to find an acceptable method by which, without injury to the iris or lens, a circular graft could be excised without recourse to scissors and transplanted into a recipient's corneal bed prepared in exactly the same manner. The graft and corneal bed so prepared would fit perfectly and have no irregularities of the margin.

Theoretical considerations

There is relatively little difficulty in completely excising the graft from the donor's cornea with a trephine but total excision of a disc from the recipient's eye without completion with scissors is difficult.

Theoretically, if a trephine is held perpendicular to the surface of the cornea and if the cornea is of uniform thickness throughout the area to be excised, the disc should be removed completely with the trephine alone since it will cut through the corneal disc in its entire circumference at the same time. However, in practice, it is almost impossible to hold the instrument

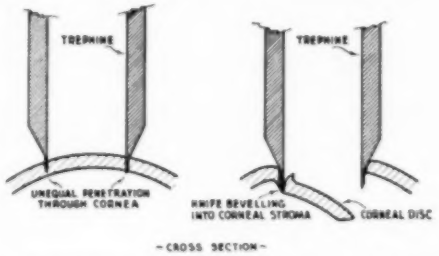

Fig. 1 (Lee and Allen). In practice it is almost impossible to hold the trephine against the cornea in precise alignment.

against the cornea in such a precise alignment.

Furthermore, in a scarred cornea, the portion to be excised may be of varying thickness, hence, the revolving blade will enter the anterior chamber more quickly at one point than at another. As soon as sufficient cornea has been cut through, the corneal disc will sag into the anterior chamber hinged at the portion which remains incompletely severed.

This sagging of the disc is the result of the force of gravity and pressure by the trephine. The blade, instead of cutting through the remaining portion of the disc, bevels into the stroma of the disc at the attached portion and continued rotation of the trephine will not accomplish the desired result (fig. 1).

Therefore, if we could prevent the downward displacement of the disc as the trephine is cutting through the cornea, we could excise it completely. The following instruments were designed toward this end.

Experimental procedures

The first instrument devised in an attempt to support the corneal disc is illustrated in Figure 2. It consisted of a fixation device and a long barrelled trephine. The fixation device was a cylinder with a rubber suction cup at one end and a rubber bulb at the other. The cylinder fitted the inside of the trephine closely so that there was no side play between the two. When the bulb was compressed, the vacuum cup placed on the cornea, and pressure on bulb released, the cup adhered to the cornea. The trephine was then lowered to the corneal surface and rotated on the cylinder of the fixation device.

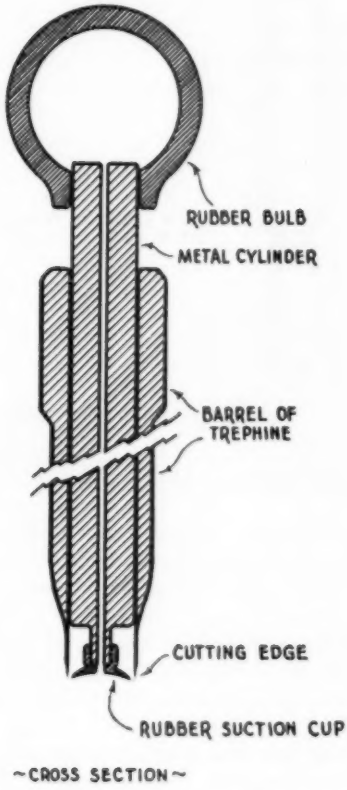

Fig. 2 (Lee and Allen). The first instrument devised in an attempt to support the corneal disc.

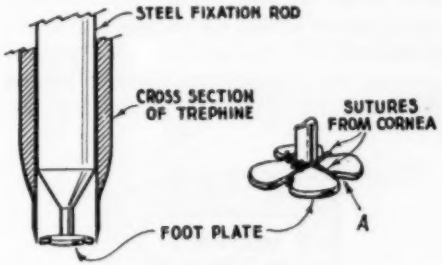

Fig. 3 (Lee and Allen). A second instrument was designed with sutures as a means of fixation. (A) For this purpose a rod with a cloverleaf-shaped footplate was used inside the trephine.

However, as the trephine cut through the cornea, the severed portion of the disc was progressively sucked into the cup, badly deforming it. The margin as a consequence became ragged. Although a complete disc was excised, it was much distorted and the corneal bed had an irregular margin.

A second instrument was designed with sutures as a means of fixation (fig. 3). For this purpose a rod with a cloverleaf-shaped footplate was used inside the trephine (fig. 3-A). In the operation, two crossed sutures were placed in the cornea within the area to be trephined and the ends of the sutures were tied across the notches in the footplate thereby holding it firmly against the surface of the cornea. One hand steadied the fixation rod, the other hand rotated the trephine which had been slipped over the rod.

As the superficial layers of the cornea were incised, the sutures lost their effectiveness upon the deeper layers. The shape of the disc was irregular and the method abandoned.

The third instrument was a modification

of Filatov's hermetically sealed F.M.3 trephine. Fine sharp threads were cut on the inner surface of the trephine blade, Figure 4, on which was mounted a von Hippel mechanical trephine motor. Sufficient resistance in the cut edge of the corneal stroma was expected so that the corneal disc would thread itself into the interior of the trephine as it cut down through the cornea. The first few experiments were successful but further trials showed the results to be inconsistent.

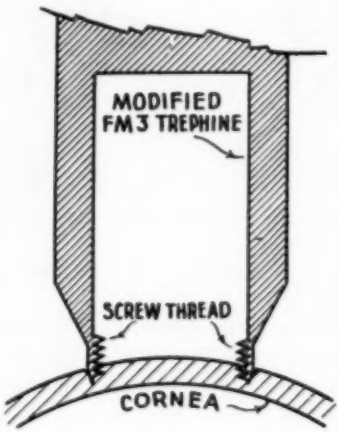

Fig. 4 (Lee and Allen). The third instrument was a modification of Filatov's hermetically sealed F.M.3 trephine. Fine sharp threads were cut on the inner surface of the trephine blade on which was mounted a von Hippel mechanical trephine motor.

Thinking that if the trephine could be held and maintained vertically to the surface of the cornea the results would be more consistent, a tripod aligning device was built, Figure 5. It consisted of a lucite sleeve free to move vertically on the shank of the trephine motor. When all three points of the sleeve were in contact with the cornea, the trephine was presumed to be vertical.

We found that this device was of little, if any, value. In addition, the fine threads soon became corroded and dull. This instrument gave promise, excising completely the corneal disc in about 50 percent of the recipient's corneas but the results were still not considered satisfactory.

Next the F.M.3 trephine was attached to a dental drill hoping that an increase in speed of rotation of the trephine would accomplish the desired result. However, this was no improvement on the previous methods.

In another instrument, we returned to our initial idea of fixing the corneal disc with some device placed at the end of a rod inside the trephine. Six fine, curved needles were imbedded in a rod of lucite as shown in Figure 6. When the needles were placed against the cornea and the rod turned, the needles were driven into the corneal stroma firmly fixing the rod to the cornea. The trephine was then lowered over the rod to the cornea and the incision made.

Fig. 5. (Lee and Allen). A tripod aligning device was added to the F.M.3 trephine.

Again, a clean cut disc was not obtained, the twisting of the rod distorted the cornea

and the margin of the corneal bed was irregular.

Next six short straight electrocautery tips projecting from the end of the lucite rode were used as means of fixation (fig. 7). The electrocoagulation effect in the cornea extended far beyond the boundaries of the area to be trephined when a current strong enough to bring about fixation was used.

Present method

Having failed to obtain adequate fixation of the corneal disc from its external surface, it was finally decided to support it from behind. An instrument was designed which seems to possess the advantages of the Filatov prophylactic spatula without most of its disadvantages. With it we have invariably obtained a completely excised corneal disc without recourse to additional instrumentation.

The instrument consists of two main parts (fig. 8). One is composed of a spatula which enters the anterior chamber to support the cornea together with a guide for the trephine blade both of which are attached to one handle. The second part is the trephine knife. The handle and support for the cornea are made of one piece of stainless steel 0.5-mm. thick. The handle is 13-mm. wide and 40-mm. long, whereas the spatula is only 5-mm. wide and 13-mm. long. The latter portion tapers off from the handle and curves in such manner as to conform to the curvature of the cornea. Its end is rounded and the last 5-mm. portion of the 13-mm. long, curved spatula is flat and marked on its top surface by small sharp grooves.

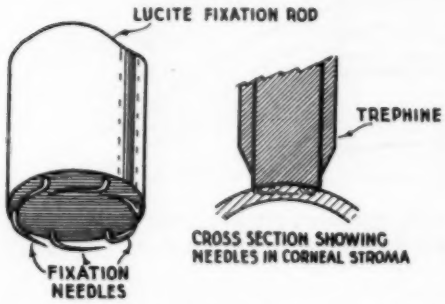

Fig. 6 (Lee and Allen). Six fine, curved needles were imbedded in a rod of lucite.

A disk of Dikor-D, rubberlike plastic, with a glosslike surface, 5 mm. in diameter and 0.5 mm. thick, is cemented over the grooved portion of the spatula with Duco household cement. This disk constitutes a pad into which the trephine may penetrate after cutting through the cornea. It guarantees complete excision of the corneal disc and protects the knife edge.

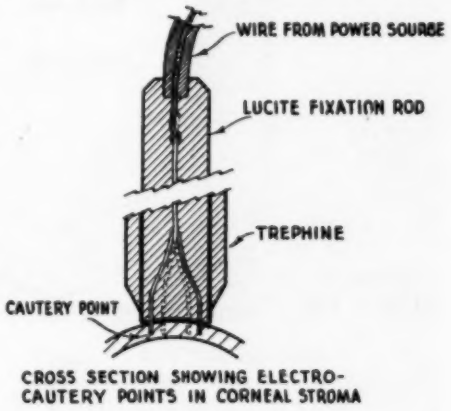

Fig. 7 (Lee and Allen). Next six short straight electrocautery tips projecting from the end of the lucite rod were used as a means of fixation.

The guide for the trephine blade is of lucite and attached at the base of the handle by two small screws. It projects upward and over the spatula so that, when the trephine blade is in the guide, the center of the trephine corresponds to the center of the plastic pad and its long axis is exactly perpendicular to the spatula's (and corneal) surface.

The trephine, which cuts a corneal disc 4.25 mm. in diameter, has a shoulder at its upper portion that permits it to slide down

the guide only far enough to penetrate the cornea and halfway through the plastic pad beneath it. This prevents contact between the delicate cutting edge of the trephine and the steel surface of the spatula.

To use the instrument, a 7-mm. wide limbic incision is made temporally with a keratome. The spatula with the plastic pad in place is introduced into the anterior chamber so that the pad lies beneath the area of cornea to be excised. The trephine is then placed in the guide and lowered to the corneal surface where, by gentle downward pressure and slow rotation, a completely excised corneal disc with smooth margin is obtained. The operation is made on the donor's and the recipient's eye with the same instrument and in the same manner. As a result, the donor's graft fits into the recipient's corneal bed perfectly. The limbic incision in the recipient's eye is closed with two interrupted corneoscleral sutures. The graft is kept in place in the recipient's cornea by a previously placed Castroviejo suture.

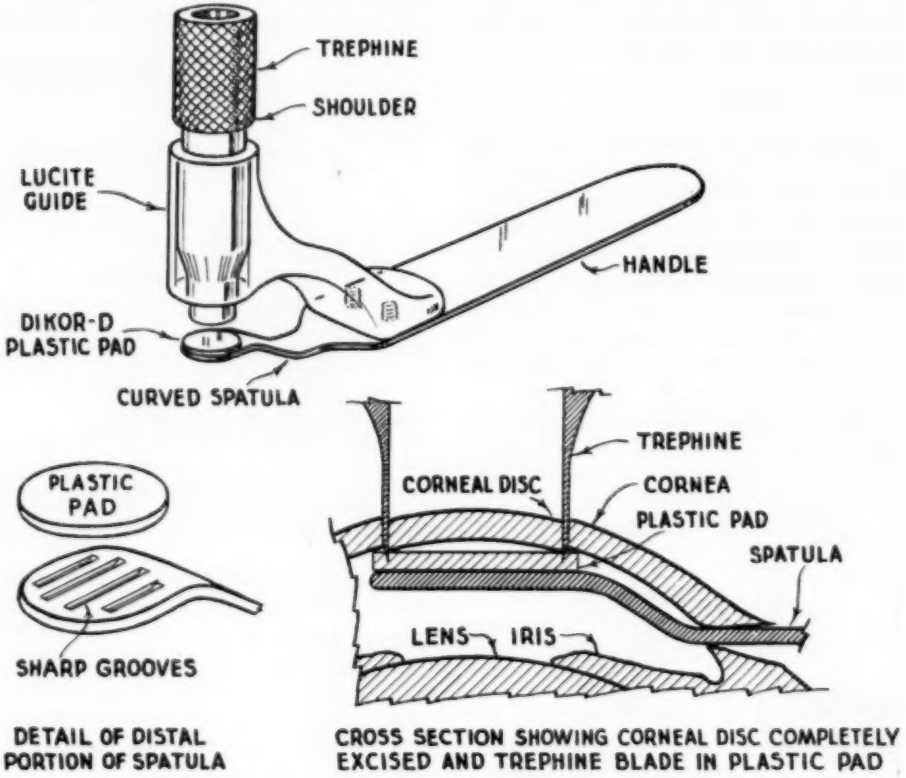

Fig. 8 (Lee and Allen). An instrument was designed to support the corneal disc from behind.

Comment

The present instrument and technique resemble the Filatov method with trephine and prophylactic spatula. However, the method differs in several important respects.

1. With the method described above, only

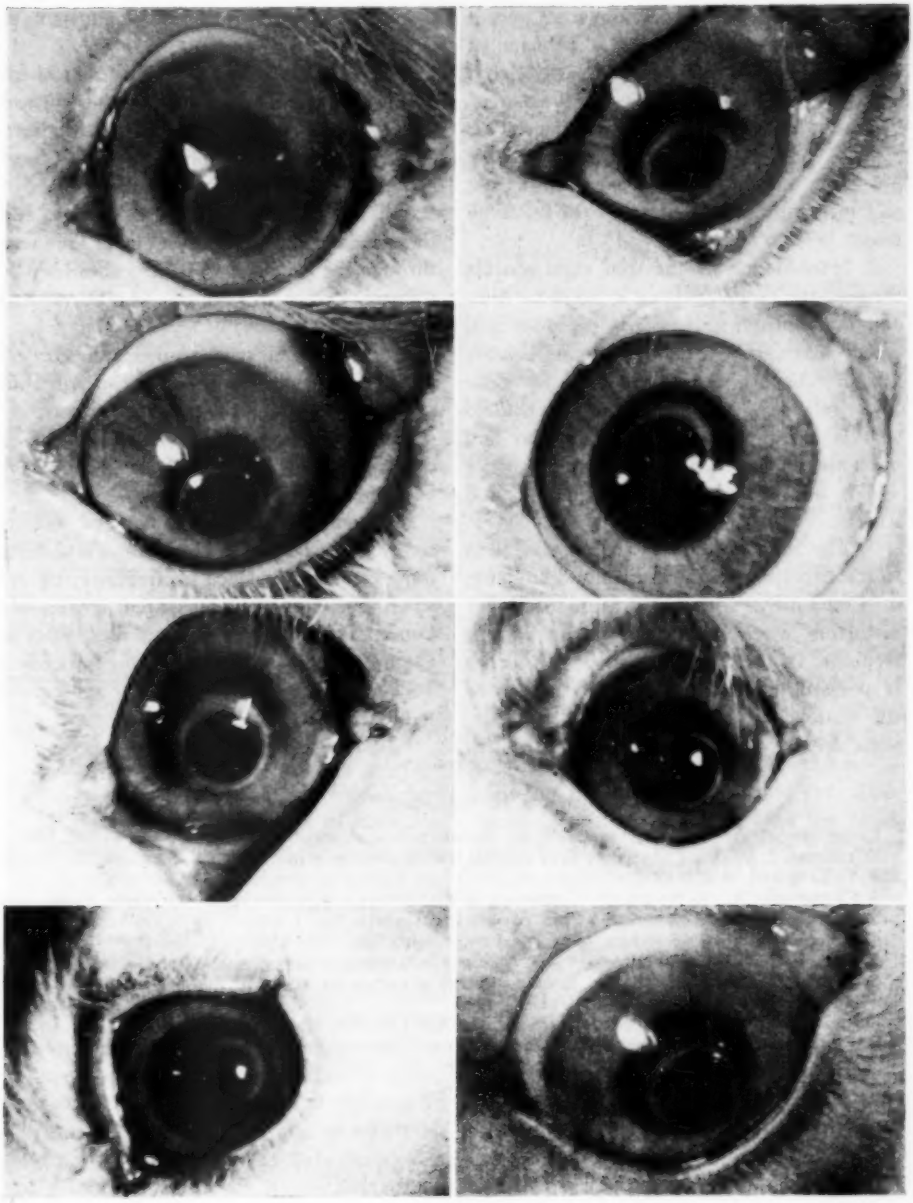

Fig. 9 (Lee and Allen). Transparent grafts obtained in rabbits with use of instrument shown in Figure 8.

one small incision is necessary to permit introduction of the spatula; it is made at the limbus with a keratome and easily closed by two interrupted corneoscleral sutures. Filatov's method requires two corneal incisions with a special knife and they are not made easily. He does not use sutures, and incarceration and prolapse of iris may result.

2. Introduction of the thin rigid spatula through the limbic incision is no more difficult than introducing an iris repositor and equally harmless if ordinary precautions are taken. Whereas, the introduction of Filatov's relatively pliable ivory or celluloid spatula through one corneal incision and out a second requires much skill and practice and is not without danger to the iris and lens.

3. The rigid and curved spatula conforms to the curvature of the cornea and supports it. Consequently, there is a minimum of distortion when the cornea is cut by the trephine. In the Filatov method, the cornea is pressed downward onto the surface of the spatula before it can be cut. This results in beveling of the margin of the corneal disc which may not be constant in every eye.

4. The soft plastic pad of this instrument assures complete excision of the corneal disc in all cases and does not dull the sharp cutting edge of the trephine. Filatov's hard spatula dulls the trephine during each application. Because the spatula is flexible and the surface hard, completion of the cut through the last layers of the cornea may be difficult except for those who have had much practice.

5. Only one other instrument, the corneal punch of Weiner-Alvis or of Tai, will consistently excise a corneal disc without recourse to scissors. However, this merit is outweighed by the disadvantages which have been mentioned.

6. Operations on a number of rabbits have been made with the method and technique herein described with gratifying results. Some of the transparent grafts obtained with this method are illustrated in Figure 9. The technique of the procedure will be presented in detail in a subsequent paper.

University Hospitals.

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THE NEW OCULAR IMPLANTS

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The naturalness of any ocular prosthesis is based on these four factors: (1) The absence of lag; (2) adequate excursion; (3) normal contour of the lids; (4) correct design and color matching of the prosthesis.

The last of these is more a problem for the artificial-eye maker, but the search for means of satisfying the first two requirements, while maintaining the third, has been the concern of ophthalmologists for centuries. Replacement of the ocular contents with the buried implants was considered a great improvement and is still used in the majority of enucleations today. These have been designed of bone, cartilage, glass, gold, fat, ivory, and many other materials. Finally, plastics and alloys were introduced in different shapes and sizes designed to impart more motility to the stump.

ABSENCE OF LAG

With these new materials, much work has been done recently in the development of ocular implants in the hope of obtaining a more natural appearing artificial eye. These implants have mechanical contact between the implant and the prothesis in direct contrast to all previous forms of buried implants. With buried implants, the ophthalmologist was able to obtain a mobile stump but not the mobile prothesis which he was seeking. Thus the problem became not one of more tissue motility but rather of transmitting this motility to the artificial eye. In the buried implant, there is no connection between the implant and the prosthesis with the result that much of the motility of the stump is lost. The new implant, with positive contact between it and the prosthesis, does not necessarily provide more movement but is designed to transmit the greater part of all of the motion to the prosthesis. Thus, lag, which is one of the prime causes of an unnatural appearance in an artificial eye, is eliminated.

ADEQUATE EXCURSION

Inadequate excursion of the prosthesis is equally important in producing the unnatural appearance of most artificial eyes. This has been improved with the new implants in two ways. First, conjunctiva is not sacrificed in covering the implant, as it is sacrificed with buried implants, because the face of most implants corresponds to the diameter of the cornea. This preserves the fornices, maintaining space for adequate excursion of the prosthesis. Second, the redesigning of the prosthesis, which has been found necessary with these new implants, permits the prosthesis to be made as small as possible—so small in fact that it will just remain within the lids and show no gap on extreme horizontal movements. Further, the curvature of the prosthesis is made to conform to that of the normal eye. These factors, which markedly reduce the weight and size of the prosthesis, permit a mechanical action which simulates that of the normal eye.

NORMAL CONTOUR OF LIDS

Since the weight and size of the prosthesis is reduced to a minimum, with the reduced weight being entirely supported by the peg to the implant, the cosmetic defect of sinking in of the upper lid and drooping of the lower lid is reduced. This is in marked contrast to the old-style prosthesis where the entire socket was filled in an attempt to maintain a normal contour of the lids. This large-size prosthesis, besides preventing a full range of motion, caused a drooping of the lower lid and a sinking in of the upper lid by its sheer unsupported

weight. It is worth while to point out that the size of the new prothesis bears no relation to the size of the socket but rather to that of the palpebral fissure.

Danger of infection

The danger of infection has often been raised as an objection to the use of these new implants since the conjunctiva is not closed. Fortunately, this has not been a troublesome factor. That infection does not develop may be due to histologic changes in Tenon's capsule with this procedure. Where these implants have been removed, the entire socket appears lined with smooth pseudomucous membrane. On microscopic section this lining was demonstrated to consist of epithelial cells.

Ruedemann[1] felt that it was not epithelium but more like endothelium, taking 11 to 12 days to form the lining of the socket. He called it pseudoendothelium.

Hughes,[2] as well as other workers, found that there was more discharge with the use of these implants than in the buried type. However, this discharge subsides in approximately 12 to 15 days and is thought to coincide with the time necessary for the socket to become epithelialized. Guyton and his co-workers[3] found that the muscles and tissues about the posterior portion of the implant were epithelialized within three weeks' time.

Allergy

Allergy was particularly bothersome in the early cases with the use of acrylic plastics by Ruedemann. However, after the implant was covered with tantalum mesh these allergic manifestations were largely overcome. No other surgeons report definite allergies. However, it is probable that a small percentage of patients will be sensitive to the plastic incorporated in the implants. These cases, it is felt, can be kept to a minimum by the proper curing of the plastics or by the use of alloys in their place.

Extrusion

Extrusion is still a prominent feature to be considered in this type of implant and is at present the most troublesome factor which most designers are attempting to solve. For evaluation of retention, cases must be separated into primary procedures —those in which an implant is inserted at the time of removal of an eye; and secondary—those in which an implant is utilized to replace a formerly buried implant.

Retention can be obtained in a higher percentage of primary implantations as compared to secondary procedures, although good results are beginning to be reported in the latter cases. None of these have been put to the test of time which, after all, is the only criterion for the evaluation of retention.

Development of new prostheses

The impetus for the development of a more satisfactory prosthesis was provided by World War II and was materially enhanced by the development of plastics and metals tolerated by the tissues.

The transition from a buried type implant to the integrated implant and prosthesis was bridged by Ruedemann[4] and Cutler,[5] the latter with his so-called "basket implant," which had the effect of creating a depression in the socket into which fitted a blunt peg on the posterior surface of the prosthesis. However, conjunctiva still separated the peg from direct contact with the buried implant. Kennedy[6] has further modified this buried implant with a ball attachment on its posterior surface that is designed to fill the socket more adequately than the original basket implant of Cutler (fig. 1).

Ruedemann was the first to demonstrate that an implant could be safely inserted within Tenon's capsule, with the muscles attached thereto, without subsequent closure of the conjunctiva.

Following this revolutionary demonstra-

tion, many modifications of implants have been designed, all of which have in common the fact that the anterior face of the implant is left exposed within the socket.

This paper will present a description and photographs of these various implants including, where needed, a brief resume of the surgical procedures involved. Other implants known to me are not included since the designers desire to present their implants individually at a later date.

Available statistics will not be presented because none of these prostheses have been properly tested by time and, consequently, the statistics cannot be submitted as conclusive at present.

Ruedemann's implant eye*

Much is owed to Ruedemann for his demonstration that an implant could be inserted within Tenon's capsule without closure of this tissue or conjunctiva. This implant

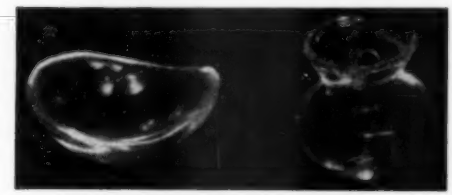

Fig. 1 (Durham). *Kennedy implant.* This implant (right) is a modification of the Cutler basket implant, having a ball attachment on the posterior part of the basket. It is still a buried type as the entire implant is covered by conjunctiva. On the left is the conformer used at operation to form the socket.

(fig. 2) differs from the others to be described in that the implant and prosthesis are one and the whole is inserted permanently within Tenon's capsule. The implant is constructed of plastic in the shape of a sphere slightly flattened anteriorly, being approximately 25 mm. in diameter at the equator and 23 mm. in the anteroposterior axis. The conjunctival and iris markings are on the anterior surface while the posterior two thirds is covered with tantalum wire mesh. This is a modification of the original Ruedemann design and has proved more satisfactory than the original.

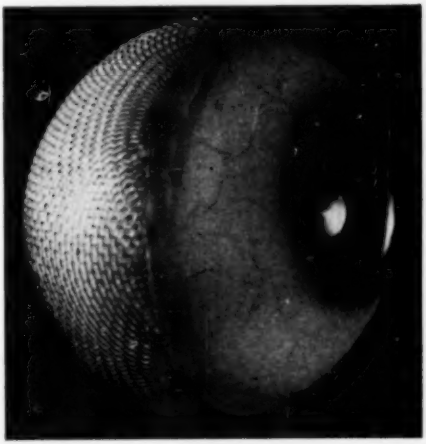

Fig. 2 (Durham). *Ruedemann implant eye.* Constructed of plastic in the shape of a sphere slightly flattened anteriorly. The conjunctiva and iris markings are on the anterior surface while the posterior surface is covered with tantalum mesh. The equator measures 25 mm. while the anteroposterior direction is approximately 23 mm. The whole is inserted permanently within Tenon's capsule and conjunctiva.

The operative procedure consists of incising the conjunctiva at the limbus in the usual manner and isolating the superior rectus (fig. 3A). A double-armed suture is placed in the tendon of the muscle and then cut with a canaliculus knife or scissors (fig. 3B). The four recti muscles are treated in this manner and the globe is removed. No effort is made to isolate the obliques, as a rule, unless the eye is unusually prominent. Each rectus is sutured to the tantalum mesh of the implant after the latter has been inserted within Tenon's capsule (fig. 3C). Each muscle is reinforced to the implant with an additional suture (fig. 3D). Tenon's capsule is then sutured to the tantalum mesh and

* Manufactured by The American Optical Company, Monoplex Eye Division, Southbridge, Massachusetts.

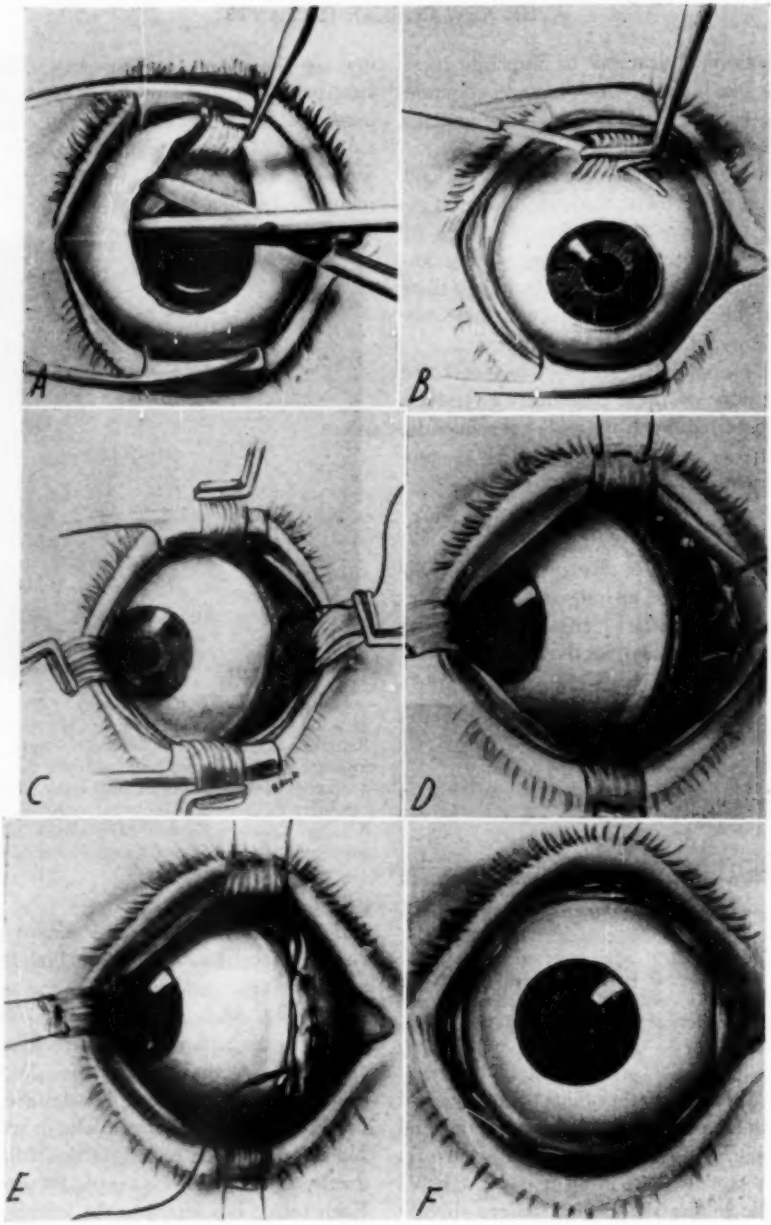

Fig. 3 (Durham). *Ruedemann implant operation.* (A) Conjunctiva is incised at the limbus and the superior rectus isolated in the usual manner. (B) Double-armed suture is placed in the tendon of the superior rectus muscle and then cut with a canaliculus knife or scissors. (C) The recti are sutured to the tantalum mesh of the implant. (D) Each muscle is reinforced to the implant with an additional suture. Tenon's capsule is then likewise attached to the implant and underlying muscles. (E) The sutures are finally carried through the conjunctiva and tied. The conjunctiva is then reinforced by single-armed catgut sutures to the edge of the implant. (F) The final appearance.

also reinforced with a double suture. Finally, the sutures are carried through the conjunctiva and tied. The conjunctiva is reinforced by single-armed catgut sutures to the edge of the implant as shown in Figure 3E. The final appearance is seen in Figure 3F.

Unfortunately, there are several disadvantages to this implant. The most outstanding is the impossibility of removing the prosthesis for cleaning or for replacement, should either be necessary. To remove the eye, a surgical procedure is necessary and is no easy matter for the tissues and tantalum mesh become as one. Although the manufacturers have tested the plastic and colors thoroughly and believe that the prosthesis will maintain color fastness for 10 years, they admit the possibility that this may not be so. Once fading occurs, replacement is necessary and can be accomplished only by surgical means.

It is also necessary to process the eye before enucleation and insertion can be made. This is more or less impossible in emergency enucleations, although the manufacturers are preparing a color kit with code numbers for rapid fabrication with the goal of 24- to 48-hour delivery.

Centering of the implant is necessary at the time of the operation to obtain a good cosmetic result. This is not always easy to obtain and squints of the eye may result either through faulty technique or subsequent contracture. In either event, later surgery consisting of essentially a strabismus procedure is required for correction.

In all fairness to Ruedemann, it must be said that in his hands excellent results have been reported. Unfortunately, this is not the experience of other surgeons. With so many disadvantages inherent in this type of implant, it is only natural that new designs should be developed in the hope of correcting these faults. A description of these implants follows. In every instance, the prosthesis is a separate unit with mechanical contact to the implant made through a pin or peg, but permitting easy removal of the prosthesis.

Cutler implant*

Cutler's was the first integrated ocular implant and prosthesis. After designing the basket implant, which was still of the buried type, Cutler[7] next fabricated a ball and ring implant. It offered several advantages over the Ruedemann implant eye. Easy removal of the prosthesis for cleaning or replacement is possible and it is not necessary to make the prosthesis before enucleation. Finally, the centering of the prosthesis is not dependent on the surgical technique entirely but simply on the placement of the pin on the posterior surface of the prosthesis.

This implant (fig. 4-A and B) is made of methyl-methacrylate with a ring, face, and pin of 14k gold. The pin is detachable and is used at the time of operation to hold the implant in place within Tenon's capsule. After the operation is completed, the pin is removed and is later attached to the posterior portion of the prosthesis by the artificial-eye maker.

The implants are made in two sizes, 19 mm. and 16 mm. The larger size is used in regular adult enucleations while the smaller size is adaptable for children or secondary implantations where the tissues of the orbit have undergone some shrinkage.

The surgical procedure with drawings, adequately described in a previous article,[7] will not be duplicated here. In a more recent modification of this implant, Cutler has lined the anterior portion of the ball with tantalum mesh in order that the tissues will adhere more firmly to the implant (fig. 4C). This, it is hoped, will guarantee a larger percentage of retention, especially in secondary implantations in which retention is always difficult to obtain.

Cutler[8] has recently advanced the use of

* Manufactured by Paul Gougelman Co., 30 North Michigan Avenue, Chicago, Illinois.

orbital implants with his development of a so-called "universal" implant. This is made from acrylic plastic in the shape of a ball with the anterior portion covered with a double layer of tantalum mesh. It is likewise made in two sizes and can be used for enucleation, partial scleral, or secondary implantations. It will not be described further in this paper since an article by Cutler on this latest design will appear in an early issue of the JOURNAL.

HUGHES IMPLANTS*

Hughes[9] has designed two implants (fig. 5-A and B), one for insertion in the sclera and the other of a ball and ring type for use in enucleations. Both types are in two sizes and are composed entirely of Vitallium. Vitallium is a casting alloy, 90 percent of which is composed of cobalt and chromium with a small percentage of molybdenum. This metal is exceptionally strong and light. It has been found to be completely inert in living tissue and has no reaction with body fluids.

The evisceration implant is in the shape of a round jug with two attachment bars just anterior to the equator for the attachment of scleral loops, thus giving greater assurance of retention. The anterior surface projects 1½ mm. above the body of the implant in order to extend through the corneal opening. The two sizes of this implant are 12 mm. and 16 mm., the former being used in children while the latter is for adult eviscerations.

The surgical technique consists of eviscerating the contents of the eye after the removal of the cornea at the limbus. Two incisions are made through the sclera posteriorly on either side to receive the attachment bars. The implant is inserted into the scleral coat through one of these incisions. Double-armed, 3-0, plain gut sutures are then passed around the bars through the opening in the sclera and are tied externally, thus pulling the bars through the sclera and anchoring it securely in place. The scleral opening anteriorly is finally overlapped to pull it snugly around the implant. The conjunctiva is then sutured around the anterior edge of the face of the implant. A surgical form is generally inserted to form the socket properly and to reduce the edema.

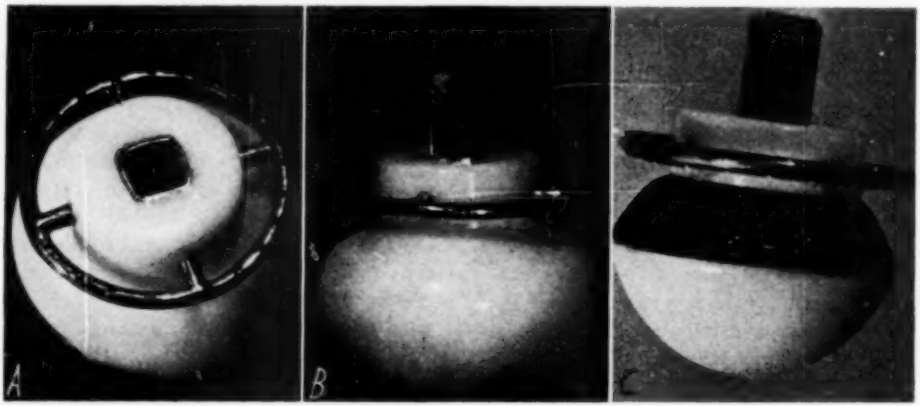

Fig. 4 (Durham). *Cutler ball and ring implant.* (A) This is constructed of methyl methacrylate and 14k gold in two sizes, 16 mm. and 19 mm. (B) Side view of implant. (C) Later modification, with double tantalum-mesh lining the anterior portion of the ball.

* Manufactured by Austenal Laboratories, 224 East 39th Street, New York 16, New York.

The Hughes enucleation implant (fig. 5) is a ball and ring implant somewhat similar to Cutler's. It differs in being made of Vitallium with four diagonal supports connecting the ring to the body. This provides four interspaces through which are pulled the recti muscles and adjacent fascia. These tissues are doubled back around the bar to be attached to themselves. The conjunctiva is attached to the tissues brought over the bar to anchor it around the exposed flat face of the implant. The anterior flat surface, 10 mm. in diameter, is identical to the evisceration implant and a surgical form is likewise used until the fitting of the prosthesis. The implant is made in two sizes, 12 mm. and 16 mm., the former being used in primary enucleations in children or in secondary implantations, while the latter is used in adult enucleations.

The surgical procedure with this implant differs only slightly from the usual enucleation operation. Each of the recti muscles are isolated at their insertions in such a way that a strip of sclera is cut with each tendon. Hughes suggests cutting the lateral rectus with its strip of sclera somewhat longer to reduce tension on the lateral aspect of the implant, thus preventing exotropia. Sutures (3-0, plain gut) are placed in each tendon and one suture in the fascia on each side of each rectus tendon. The tendons are then brought through the bar and tied back on themselves. Likewise the sutures in the fascia are brought through the bar on either side of the tendons and tied in a similar manner. The conjunctiva is then purse-stringed over the ring and sutured to the underlying Tenon's capsule and muscles.

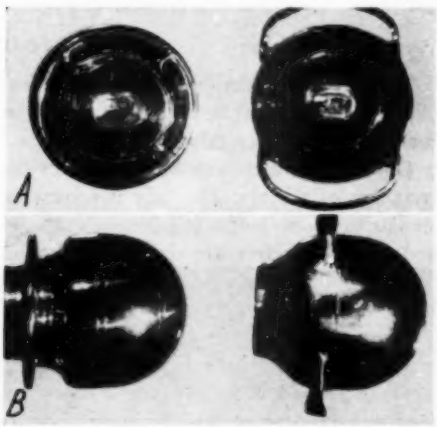

Fig. 5 (Durham). *Hughes implants.* (A) Ball and ring Vitallium implant on the left and the evisceration Vitallium implant with the scleral attachment bars on the right. (B) Side view. Enucleation implant on the left and evisceration implant on the right.

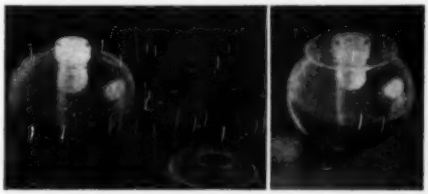

Fig. 6 (Durham). *O'Brien implant.* Constructed of Lucite, this implant consists of two portions, a ball and disc as shown on the left and the disc inserted on the neck as shown on the right.

O'Brien implant

The O'Brien[10] implant is of the evisceration type. It is made of Lucite and designed in two sections (fig. 6). The implant itself is 15 mm. in diameter but slightly flattened anteriorly, being 13 mm. anteroposteriorly, which makes it not quite spherical in shape. The posterior portion has a radius of 7.5 mm. The neck or cylindrical portion in front is 1.8 mm. long by 4.25 mm. in diameter. The hole in the neck for the reception of the prosthetic peg is 3 mm. in diameter by 7 mm. deep. A pinhole penetrates one side of the cylinder for the insertion of a silk suture to aid in pulling the implant through the trephine opening of the cornea.

The portion just described is inserted into the sclera with the neck protruding through the corneal trephine opening. A disc or

collar is then cemented to the implant proper with a small amount of Duco household cement. This disc is 9 mm. in diameter with a thickness 1 mm. at the center, tapering to 0.5 mm. at the edge. The posterior surface has a radius of curvature of 7.9 mm.

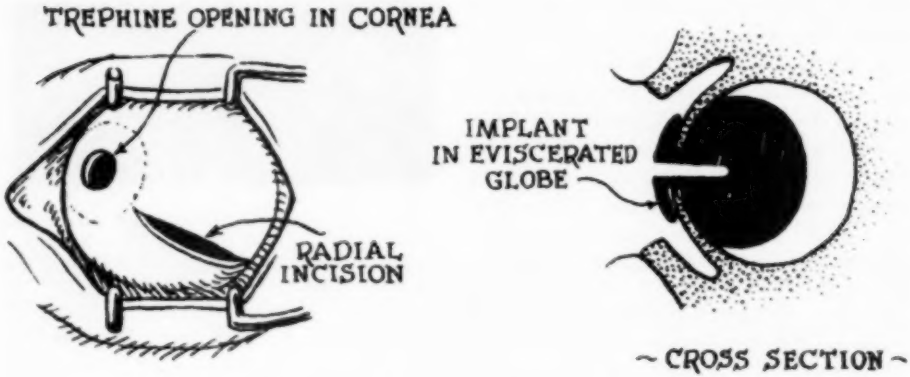

Fig. 7 (Durham). *O'Brien implant.* Diagrammatic drawing of the operative procedure.

to allow the disc to lie concentric with the corneal curvature. The peg on the posterior surface of the prosthesis is approximately 5 mm. in length, tapering from 3 mm. at the base. This peg inserts within the hole in the neck of the implant.

The operative technique consists of making a trephine opening in the center of the cornea followed by a radial incision approximately 18 mm. in length between the lateral and interior recti muscles just behind the limbal margin (fig. 7). The contents of the globe are then eviscerated through this radial incision, after which the inside of the globe is swabbed with tincture of iodine followed by cocaine solution. The implant is inserted through the corneal opening. The sclera and conjunctiva are then sutured, after which the collar is attached to the neck of the implant with Duco cement.

Fig. 8 (Durham). *Whitney implant.* (Left) Side view, acrylic plastic implant covered with tantalum mesh on the anterior two thirds. (Right) Anterior view showing tantalum tube for the reception of the pin.

Whitney implant

Whitney[11] has designed an acrylic implant covered with tantalum mesh except for the posterior one third (fig. 8).

The apex contains a tantalum tube for the reception of the pin. The tube is somewhat similar to the neck of a jug. Tenon's capsule and the conjunctiva are drawn up around the neck after the muscles have been attached to the mesh in their proper positions. Whitney felt that this particular design lessened the amount of exposed surface of metal in the socket, but as yet he has reached no conclusions as to whether this was particularly advantageous. This does have the effect of shortening the conjunctiva and therefore may be a factor in reducing total movement of the prosthesis.

GUYTON IMPLANT*

The Guyton implant[3,12] is of plastic composition having holes through the body of the implant through which the opposing recti are sutured to each other (fig. 9). The implant is 15 mm. in the anteroposterior measurement and 17 mm. at its widest portion posteriorly. The anterior portion is 11 mm. wide. The holes in the neck of the implant are 5 mm. in diameter and are at right angles to each other. The holes are centered 6 mm. behind the face plate.

The operative technique differs from the other previously described enucleations in that the opposing recti muscles are sutured to each other through the holes in the anterior portion of the implant. The conjunctiva is then drawn over the muscles with either a purse-string suture or several interrupted sutures.

The range of motion with this implant is not so great as that obtained with some of the other designs. This is probably due to the fact that the muscles are attached to one another instead of directly to the ring, thus losing some motion due to the sutured muscles sliding on the implant.

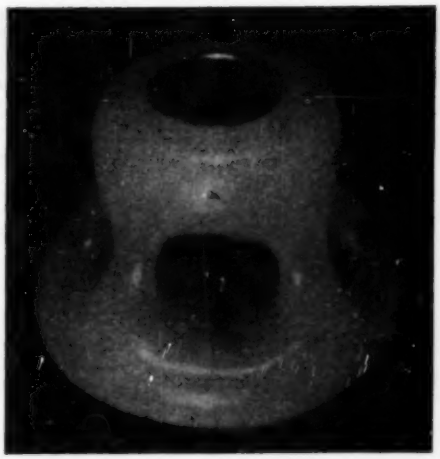

Fig. 9 (Durham). *Guyton implant.* Plastic implant showing through and through holes for the suturing of the opposing recti muscles.

ILIFF IMPLANT†

The Iliff[13] implant (fig. 10-A and B) is a modification of the Guyton implant in that the implant is constructed in two halves (anterior and posterior), the two being screwed together at the time of operation (fig. 10C). This procedure affords greater ease in suturing the muscles. A rod screws in place which gives the assistant a handle to steady the posterior half at the time of the suturing of the muscles. The anterior half is then slipped in place and one screw fastened before the holder is removed.

The results obtained with this implant should be essentially the same as with the Guyton implant—the difference being in the greater ease of handling the Iliff implant at the time of operation.

* Manufactured by Co-operative Dental Laboratories, 12 West Madison Street, Baltimore, Maryland.

† Manufactured by Gibson & Doty, 652 Main Street, Buffalo, New York.

Fig. 10 (Durham). *Iliff implant.* (A) Modification of the Guyton implant showing construction of the anterior and posterior halves. (B) Showing rod screwed in place providing a handle to steady the posterior half while suturing the muscles in place. (C) Final appearance of the two halves screwed together.

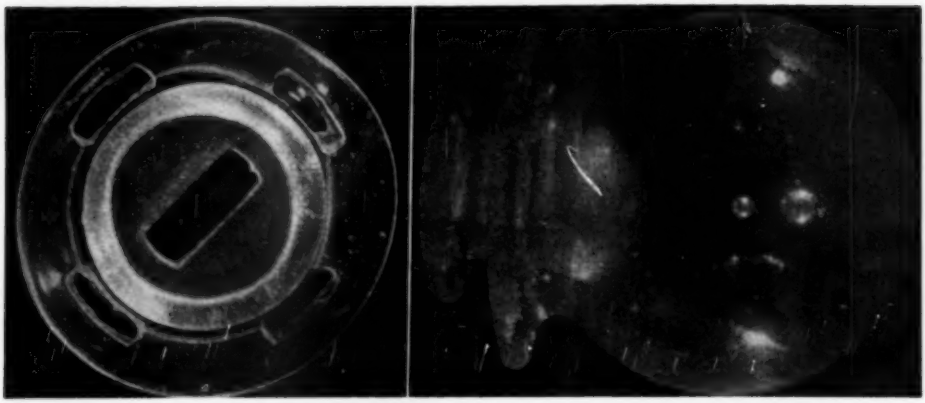

Fig. 11 (Durham). *House implant.* (Left) Anterior view showing the eyelets through which the recti muscles are drawn. (Right) Side view showing the collar, neck, and anterior button extending from the sphere.

House implant

House[14] has designed an all-acrylic plastic implant in one piece consisting of a sphere, a collar, a neck, and a button (fig. 11).

Four eyelets are placed in the collar for the reception of the recti muscles. The implants are made in three sizes with the main difference being in the spheres. These sizes are 16, 18, and 20 mm.

The operative procedure is that of the usual enucleation following which the implant is inserted and the four recti muscles are pulled through the eyelets by previously placed sutures. These sutures are then carried through the overlying Tenon's capsule and conjunctiva and tied externally. Tenon's capsule and conjunctiva are purse-stringed around the neck of the implant leaving the button, with its hole for reception of the peg, exposed within the conjunctival sac.

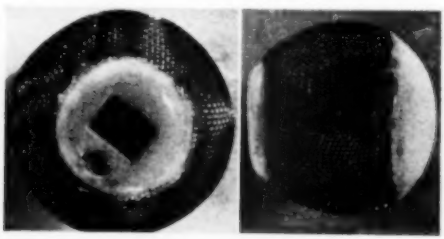

Fig. 12 (Durham). *The Stone-Jardon implant.* (Left) Anterior view. (Right) Side view showing double tantalum mesh with exception of the posterior portion. Shown also is the absence of a neck or anterior protrusion from the sphere as is common with the other implants.

Stone-Jardon implant*

The Stone-Jardon[15] implant is a pear-shaped methyl-methacrylate sphere covered with double-thickness tantalum mesh with the exception of the face and the posterior one third (fig. 12). These spheres are prepared in four sizes—15, 17, 19, and 20 mm. in diameter. The operative procedure consists of suturing the four recti muscles to the tantalum mesh of the implant by means of 5-0 braided tantalum sutures. Heavy silk sutures are used to attach Tenon's capsule to the tantalum mesh. The conjunctiva is then purse-stringed with black silk sutures, passing the sutures through the tantalum mesh also. Stone feels that a better cosmetic result is obtained if the superior rectus is placed 3 mm. from the limbus, with the

* Manufactured by American Optical Company, Monoplex Eye Division, Southbridge, Massachusetts.

other muscles being attached at the limbus of the implant. The majority of cases in which this implant was used were satisfactorily fitted with stock plastic eyes.

Conclusions

The new ocular implants improve the cosmetic appearance of the patient in a number of ways. The mechanical contact between the implant and prosthesis transmits all the motion present in the stump to the artificial eye and does it instantly. Thus lag is prevented. In addition, conjunctiva is not sacrificed in order that the implant be buried. This has the effect of maintaining the fornices and permitting adequate excursion of the prosthesis.

Redesigning of the prosthesis has contributed greatly to an improved cosmetic appearance. The prosthesis is made as small as possible; so small that it will just stay within the lids and show no gap on extreme lateral movements. This permits greater excursion and also reduces the weight and size to a minimum. Since the prosthesis with its reduced weight is supported by contact to the implant, drooping of the lower lid and sinking in of the upper lid are reduced. The adequate excursion of the prosthesis, together with the elimination of lag and the maintaining of the normal contour of the lids, results in an excellent cosmetic appearance.

There is no doubt that the last word has not yet been heard in the development of the integrated implant and prosthesis. However, the preliminary work and experimentation are over. The future will produce many changes and modifications, but the basic idea of an integrated implant and prosthesis with the former imbedded in Tenon's capsule or in sclera should remain. It is hoped that time will prove this an adequate procedure to replace one which, at its very best, was manifestly inadequate.

Summary

1. The factors contributing to the unnatural appearance of an artificial eye are discussed.

2. The means of overcoming these factors through an integrated ocular implant and prosthesis are presented.

3. The Ruedemann implant eye, together with the integrated implants of Cutler, Hughes, O'Brien, Whitney, Guyton, Iliff, House, and Stone-Jardon are described.

4. The operative procedure with each implant is outlined.

Medical Arts Building.

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PIGMENTARY GLAUCOMA*

A RARE CLINICAL ENTITY

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The search for the cause or causes of the various glaucomas has slowly led to the establishment of certain etiologic factors, especially in the secondary glaucomas and in the narrow-angle acute primary glaucoma, yet the cause of chronic simple glaucoma still remains obscure. It appears that even here we are dealing not with a single disease entity, but with a group of clinically related conditions. One of the glaucomas, which was formerly included in the chronic simple glaucoma group and is now classed as secondary, is glaucoma capsulare, that form of glaucoma associated with long-standing exfoliation of the zonular lamella of the lens capsule. This paper is an attempt to whittle another more rare glaucoma, which we designate as pigmentary glaucoma, from the larger group.

PIGMENT DEPOSITION AND OCULAR TENSION

The question of pigment dispersion and deposition in relation to the cause of glaucoma has been brought up time and again since its first introduction by Levinsohn[1] in 1909. Koeppe[2] has been the outstanding advocate of the theory that the pigment has a significant causal relationship to the increased intraocular pressure. Although Levinsohn and Koeppe had many followers, including Otto Barkan,[3] several others including Vogt, Birch-Hirschfeld, and Comberg[4] have been opposed to this view.

There are many reasons why it is difficult to evaluate the relationship of pigment deposition to increased intraocular pressure. First of all, pigment-granule deposits in the trabecular spaces are a constant occurrence in senile eyes and are found in diabetes and other pigment epithelial degenerations not associated with glaucoma, as well as in capsular exfoliation without glaucoma. In addition, it is not a constant finding in chronic simple glaucoma. Sugar found it present in 100 of 199 such eyes and considered it debatable whether the pigment deposition resulted from the glaucoma or was a coincidental senile process. It should be noted here that the pigment granules being discussed are not the chromatophore pigment which is visible in the rudimentary pectinate ligament tissue on the trabecular wall.

Evidence that pigment deposition may cause increased intraocular pressure by mechanical blockage of the trabecular spaces was presented by Bothman.[5] He reported the histologic findings in the eye of a 62-year-old man who had received large doses of roentgen rays and radium, much of it without protection, and subsequently developed a unilateral glaucoma in the irradiated eye. There was dispersion of pigment from the ciliary processes and posterior iris surface which was deposited in the trabecular spaces. Bothman stated that vascular changes played no role in this case since the blood vessels were no different from those of patients of the same age without increased intraocular pressure.

On the other hand, Birch-Hirschfeld[6] felt that the changes in two irradiated eyes which he studied arose from injury to the blood vessels from the roentgen rays. In one of the cases glaucoma did not develop.

* From the Wayne University College of Medicine.

In 1940, in discussing the question of pigment in the trabecular spaces, one of us (H. S. S.) mentioned briefly the case of a 29-year-old man in whom the trabecular pigment deposit was so heavy that it suggested itself as the causative agent. Since then, no such case had been encountered until January 20, 1947, when the second case was seen by one of us (F. A. B.) and subsequently studied by both of us. The findings, both clinical and gonioscopic, were so similar in both cases as to indicate that we were dealing with a rare clinical entity. A description of both cases follows.

Case reports

Case 1. F. C., a 29-year-old man, was first seen on February 10, 1939. He complained of having seen colored rings about lights each time after viewing a motion picture during the previous year.

Eye examination. His first tonometric readings were: R.E., 35 mm. Hg; L.E., 37 mm. Hg (Schiøtz). His visual acuity was: R.E., 20/15, with a −1.25D. sph.; L.E., 20/15, with a −1.25D. sph. ⊂ −0.25D. cyl. ax. 90°. Biomicroscopically there was evidence of intraocular pigment dispersion. Pigment granules were deposited on the anterior iris surface, on the posterior surface of the cornea in the form of a Krukenberg spindle, and in the trabecular spaces to form a dense trabecular pigment ring (fig. 1). The anterior chambers were each 3.0 mm. deep. There was no evidence of inflammation. The discs and fundi were entirely normal.

The visual fields remained normal until the last ones, taken on September 14, 1940, when the 1/330 white field was entirely normal, the 3/330 red field was slightly reduced on the left, and the 2/1000 white target showed the left blindspot to be enlarged to twice its normal size.

A tension curve study was started without drops on February 10, 1939. It revealed tonometric (Schiøtz) readings at 9:30 a.m. of R.E., 35 mm. Hg; L.E., 45 mm. Hg. At 12:15 p.m. the readings were: R.E., 49 mm. Hg; L.E., 52 mm. Hg.

Instillations of pilocarpine nitrate (2 percent, 4 times daily) were started. At 3:00 p.m., the readings were 24 mm. Hg, O.U. On the following day at 10:45 a.m., tension was: R.E., 21 mm. Hg; L.E., 10 mm. Hg; at 2 p.m., O.U., 21 mm. Hg. On the next day at 9:30 a.m. they were: R.E., 19 mm. Hg; L.E., 22 mm. Hg.

On continued pilocarpine therapy the tension remained normal most of the time but

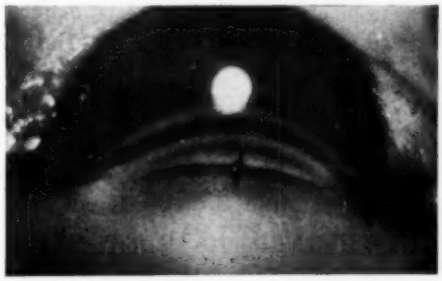

Fig. 1 (Sugar and Barbour). Goniophotograph of trabecular wall showing trabecular pigment ring (between arrows) in case of "pigmentary glaucoma."

varied between 37 and 18 mm. Hg in the right eye, and 37 and 15 mm. Hg in the left eye until November 16, 1940. On several occasions when homatropine was used for cycloplegia and mydriasis, the tension rose to the high 40's within an hour.

On December 15, 1947,* seven years later, the corrected visual acuity was still 20/15 with each eye. The tonometric readings were: R.E., 43 mm. Hg, and L.E., 28 mm. Hg (Schiøtz) under 1-percent pilocarpine, 3 times daily. The visual fields showed only a 5-degree lower nasal field loss in the left eye (1/330 mm.).

Case 2. R. A., a 33-year-old man, was first examined by one of us (F. A. B.) on January 20, 1947. His visual acuity was: R.E.,

* This examination was done in Chicago through the kind aid of Dr. Sidney Penn.

20/20, with a −3.0D. sph. ⌒ +1.25D. cyl. ax. 8°; L.E., 20/20, with a −2.5D. sph. ⌒ +1.0D. cyl. ax. 172°. The tension was: R.E., 40 mm. Hg; L.E., 30 mm. Hg (Schiøtz). The anterior chambers were deep and Krukenberg spindles were present. Following the use of 2-percent pilocarpine every hour, tension was: R.E., 24 mm. Hg; L.E., 14 mm. Hg. On 0.5-percent pilocarpine, 3 times daily, the tension remained between 30 and 35 mm. Hg in the right eye and 20 to 25 mm. Hg in the left. In April, 1947, medication was changed to 1-percent homatropine, 3 times daily. The tension rose to 40 to 45 mm. Hg, R.E., and 30 to 35 mm. Hg, L.E. This was discontinued and pilocarpine started and used in 2-percent concentration at night and 1-percent in the morning. The intraocular pressure in the right eye has measured between 26 and 33 mm. Hg and in the left eye, between 25 and 28 mm. Hg. On March 30, 1948, the corrected visual acuity was 20/20 each eye. The visual fields with a 3/330 test object were entirely normal. The gonioscopic examination on May 27, 1947, revealed a very dense trabecular pigment ring of exactly the same appearance as in Case 1. On the last examination on November 16, 1948, the intraocular pressure was: R.E., 28 mm. Hg; L.E., 26 mm. Hg.

The two cases presented the following parallels: Both occurred in young myopic individuals with degeneration of the pigment epithelium of the iris and ciliary body, both showed marked deposition of the pigment granules in the trabecular spaces and the presence of Krukenberg spindles. Both responded to mydriasis by increased intraocular pressure, yet neither of them had any narrowing of the chamber angle. Both were improved with pilocarpine. These cases, then, present clinical characteristics of chronic simple glaucoma with the exception of the response to mydriasis.

Summary

Two cases of a form of glaucoma designated as pigmentary glaucoma are presented. The authors believe this form of glaucoma to be a distinct entity.

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Ophthalmic Miniature

In cases of inflammation of the eyes when headache occurs and remains for a long time, loss of sight is to be feared.

Works of Hippocrates,
4th Century, B.C.

A NEW CLASSIFICATION OF NONPARALYTIC STRABISMUS*

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Previous classifications of nonparalytic strabismus have done much to help clarify the subject. Considerable confusion, however, regarding etiology and treatment still continues. Adding another classification to the many that exist is only justified if it helps to indicate the etiology of the strabismus or helps in the planning of the treatment. At a time when much publicity is given to "orthoptic" training, a classification which more accurately helps to evaluate results of such treatment should be particularly desirable.

It is usual for presentations of classifications to emphasize the relation of the various etiologic factors to the particular classification. According to Pugh's[1] classification each group of cases has its own explanation. One group belongs to the "accommodative type" (Donders[2]). Despite the existence of similar errors of refraction other groups are not considered to be of this type. The fallacy of such a separation based primarily on response to a mode of treatment is apparent, and has already been noted by Davis.[3] He observed that some cases similar in other respects to the "accommodative" type were probably prevented from responding to glasses because of structural muscle changes.

In another group the cases are explained by the fusion-defect theory. This theory of Worth's[4] is based primarily on the assumption of an "abnormally weak fusion faculty." However, the theory is based on the results of examination of patients with strabismus who by the time of the test have developed such complications or sequelae as amblyopia and possible structural muscle defects. The demonstration of a normal fusion faculty under such conditions is notably faulty. A study of the development of the visual mechanism calls to mind that the wandering movements of the eyes during the first 6 to 8 months of life gradually decrease as (1) the macula is uncovered; (2) the convergence function develops ability to control binocular fixation; (3) experiences of the individual accumulate to help form impressions necessary for stereopsis; and (4) the cerebral mechanism, involved in the formation and appreciation of a composite mental picture, develops during the first eight years of life.

The fact that most cases of strabismus (without ocular disease) occur before the fifth year of life suggests that the cerebration process, called the fusion faculty, is normally receptive to disturbing factors during the early period (Priestly Smith).[5] This susceptibility of the fusion faculty should be regarded as normal, during the developing period. This is further emphasized by calling attention to the evolutionary youthfulness of the fusion mechanism (convergence).

It is a well-known principle that the newer evolutionary function is the first to show disturbances in times of stress. Appreciation of the possibility that an abnormally weak fusion faculty need not be the cause of strabismus may permit a more careful search for the factors involved.

There is no doubt that such anatomic factors as orbital asymmetry, longer or shorter muscles, and so forth, may be sufficient barriers to the normal functioning of the binocular mechanism. Separation of these cases from the others is a necessary step in understanding the various factors involved in all cases.

In general it has been pointed out in the literature that hyperopia tends to cause convergent strabismus and myopia tends to

* Presented at the Chicago Ophthalmological Society, October, 1946. Presented in part at the Los Angeles Society of Ophthalmology and Otolaryngology, September, 1946.

cause divergent strabismus. However, many hyperopes show a divergence and a fair number of myopes show a convergence without adequate explanation (Worth,[6] Stevens,[7] Van der Hoeve,[8] Bielschowsky[9]).

The relation of the refraction to the form of strabismus is not so easily dismissed as followers of Donders would wish. Thus far the data is confused by such factors as: (1) Failure to separate the anisometropic type from the isometropic type; (2) averaging the meridional refractions according to the method of Jackson (which labels as emmetropic cases of mixed astigmatism, such as a −3.0D. sph. ⊃ +6.0D. cyl.); (3) using disproportionately fewer cases of strabismus to compare with many more cases without strabismus; (4) failure to use proper survey methods to obtain cases for comparison.

Tassman's data[10] are typical of the better data available. His data suggest the possibility, noted in the study by Brown and Kronfeld,[11] that the wearing of glasses may have an affect on the further changes in refraction.

Donders noted the possibility that in the high hyperopes no effort is made to overcome the error of refraction, hence the poor vision in these cases. That this is likely is shown by the resulting poor vision in these cases when first corrected (bilateral amblyopia).[12] Further study of these relationships is in order.

Such types of strabismus as periodic and constant are usually mentioned. However, when a classification or an analysis of findings and results of treatment are presented such types (periodic and constant) usually are not separated. (Some, like Maxwell,[13] advise treatment of intermittent type to prevent case from changing to constant form.)

Similarly the differences in refraction between the two eyes are noted, and the terms isometropia and anisometropia are used. The difference in type and degree of amblyopia in cases of strabismus with and without anisometropia as compared with anisometropia without strabismus has been emphasized by Straub.[14] Anisometropia as a cause of strabismus has been noted by many (Lloyd).[15] However, in studies of refraction curves and in classifications and analyses the isometropic and anisometropic types are usually not separated.

Unilateral ocular disease as a factor in strabismus is well known. Bielschowsky[9] presented considerable data concerning this factor. The strabismus in these cases is nonparalytic. However, classifications thus far presented do not include these cases. Including them may help form a more complete picture of the subject.

Adler,[16] together with others (Deloge,[17] Parinaud,[18] P. Smith[5]), many years before him, calls attention to the part played by the convergence function in the production of strabismus. The cases suggestive of overactivity are better presented than those suggestive of underactivity. There is still considerable work to be done before a clear picture of the relation of the convergence function to the strabismus problem is possible.

While the general health is admittedly a factor in the etiology of strabismus, the method in which this factor works is not clearly understood. It is probably for this reason that this factor is most frequently neglected in the classifications after being given "honorable mention" in the discussion. Bielschowsky,[9] Maxwell,[13] Tassman,[10] point out that the frequency of a history of trauma or some other illness (such as measles, whooping cough, and so forth) in relation to the onset of strabismus suggests general health as an exciting factor in the production of the strabismus.

The lack of understanding as to cause and effect, and the lack of clarity in the interpretation of response to various therapeutic procedures are reflected in the multiplicity of the theories, methods of treatment, and definition of terms.

More accurate evaluation of the conditions

leading to and following the onset of strabismus will permit emphasis on the factors which should more properly be considered primary or exciting factors and those which should be considered secondary factors. The fact that it may be of more importance to treat these secondary factors, and sequelae, in cases which have existed for any considerable time should not blind us to an appreciation of cause and effect. In only this way can a truly helpful attitude be developed in outlining the prophylactic and specific therapeutic measures necessary in the treatment of strabismus.

Classification

A total of 1,054 cases of strabismus have been analyzed and grouped on the basis of clinical findings, particularly in reference to visual efficiency; type of strabismus (constant or periodic, monocular or alternating, convergent, divergent, vertical or mixed); and presence or absence of ocular disease or abnormality.

The classification in Table 1 was found

TABLE 1

Classification of nonparalytic strabismus based on 1,054 cases

- A. Isometropic (Equal Ocular Efficiency at Onset)
  - I. Periodic (Intermittent)
    - a. Alternating
      1. Convergent
      2. Divergent
      3. Sursumvergent
      4. Mixed
    - b. Unilateral
      1. Convergent
      2. Divergent
      3. Sursumvergent
      4. Mixed
  - II. Constant
    - a. Alternating
      1. Convergent
      2. Divergent
      3. Sursumvergent
      4. Mixed
    - b. Unilateral
      1. Convergent
      2. Divergent
      3. Sursumvergent
      4. Mixed
- B. Anisometropic (Unequal Ocular Efficiency at Onset)
  - I. Nonpathologic
    - a. Periodic
      1. Alternating
         (a) Convergent
         (b) Divergent
         (c) Sursumvergent
         (d) Mixed
      2. Unilateral
         (a) Convergent
         (b) Divergent
         (c) Sursumvergent
         (d) Mixed
    - b. Constant
      1. Alternating
         (a) Convergent
         (b) Divergent
         (c) Sursumvergent
         (d) Mixed
      2. Unilateral
         (a) Convergent
         (b) Divergent
         (c) Sursumvergent
         (d) Mixed
  - II. Pathologic (Loss of Vision due to Obvious Monocular Pathology)
    - a. Constant
      1. Unilateral
         (a) Convergent
         (b) Divergent
         (c) Sursumvergent
         (d) Mixed
- C. Anatomic
  - I. With total blindness (Note 3).
  - II. Without ocular disease

Note 1. One type of case may become another. For example, a case of unilateral cataract or aphakia belongs to B. II. a. 1. On removal of both cataracts the case may more accurately fit into B. I. or A., depending on the final refraction. Or a case from A. II. b. may, after treatment of the amblyopia, become A. I. or A. II. a.

Note 2. Cases of bilateral disease in which the vision is more markedly reduced in one eye follow the pattern as noted in the classification for monocular disease.

Note 3. Cases of bilateral disease leading to total blindness, or practical blindness with nystagmus, may result in loss of fixation with the eyes assuming a position of divergence (position of rest) alternating or bilateral in character. Their addition to the classification is only for the sake of completeness. Cases of this type are not included in this report.

applicable to all cases of nonparalytic strabismus regardless of age of onset or presence of disease.

In the above classification, the term "isometropic" refers to approximate equality in refractive power in the eyes in each case. In no case in this group was the difference in the amount of sphere as much as 1.5D. The amount of astigmatism did not differ by as much as 1.25D. No case showed a difference between the two eyes as great as 2.0D. in the principal meridians. These figures were based on a previous study on amblyopia,[12] in which such differences as above noted were considered factors in the visual efficiency (see also Grimm,[19] Lloyd,[15] Deloge[17]). In no case in this group (isometropic) was ocular disease demonstrable.

Anisometropic refers here to those cases showing greater differences than allowable under the classification of isometropic, plus those cases showing unilateral or materially unequal ocular disease.

An examination of 1,054 cases of nonparalytic strabismus, occurring at all ages from birth to senility, using this classification as a guide, revealed the following: 737 cases belonged to the isometropic type, 317 to the anisometropic type. Of the isometropic cases 544 or 73.8 percent were of the convergent type. Only 193 or 26.2 percent were of the divergent type. Of the isometropic cases 268 or 36.3 percent were of the intermittent or periodic type; 469 or 63.7 percent were of the constant type. Of the 317 cases of anisometropic type, only 38 or 12.0 percent were of the convergent type, while 279 or 88 percent were of the divergent type.*

Only 16 of the anisometropic cases were intermittent or periodic in type, while 301 or 94.9 percent were of the constant type.

It is obvious that whether the unequal ocular efficiency is congenital or acquired the results tend to be the same—the strabismus when present will tend to be of the divergent type. When the visual efficiency is equal, the strabismus, if present, more likely will tend to be convergent in type. There is some evidence to suggest that divergent strabismus of the isometropic type when present tends to occur early in life before the convergence function has made any progress (Worth[4]).

The convergent form tends to occur after the age of six months when the convergence function is actively developing. Its onset is rare after the 10th year (Bielschowsky[9]) when the convergence mechanism is fully formed and under functional control. The expressed thought (Lloyd[15]) that overconvergence is an attempt to avoid diplopia and aid suppression does not hold for two reasons: (1) diplopia is not avoided by displacement of images, but by suppression; (2) displacement could as easily be accomplished by divergence, and so should be present in equal frequency in these cases, which does not occur. The more likely explanation is that an overconvergence is due to less effective control by a higher center with resultant establishment of this behavior pattern.

There are sufficient data available to justify considering the exciting factor in the isometropic type as a general disease or trauma which by decreasing the available energy may produce a retardation of the normal process involved in the full development of the fusion faculty, just as in such cases there may be a retardation in talking or walking.

This view would make the normally "young" underdeveloped fusion sense a major predisposing but not an exciting factor in this form of strabismus. The question of whether or not a squint is to continue at all and whether it is to take the form of an intermittent or constant type (alternating or unilateral) depends on the speed and the completeness of recovery from the exciting cause and on the development of complications as well as on secondary factors, such as age of onset and state of the fusion sense.

* This number would depend on the number of cases seen with unilateral disease.

A cyclotropia present at birth should prevent fusion from developing and thus its presence may be hidden by horizontal and/or vertical deviations. Actually it is an exceedingly rare condition. When present, a case of cyclotropia would be likely to belong to the paralytic or to the anatomic type.

Cases with marked vertical factors (pure or mixed) may have an anatomic or an organic basis. Further study of these relatively infrequent cases is necssary before definite conclusions can be drawn concerning their exact place in the classification.

Where anatomic factors are present, they may be considered as exciting factors in the production of the strabismus, if the strabismus is present from birth. Where the strabismus is acquired later, the anatomic factors should be considered secondary, as the organism had the power to develop some fusional activities despite the anatomic factors. When anatomic asymmetry or defects are present, these may be of such degree as to make it impossible for the convergence to function. In borderline cases in which some convergence function has existed, as in cases of anisometropia, the general health factor may be an additional exciting factor.

In adults, and occasionally in early years, when the vision of one eye becomes markedly different from that in the other because of definite disease, the anisometropia thus created can be considered the exciting factor in production of the strabismus. Deloge lists, among causes of strabismus in adults, conditions which may produce a difference in vision, such as late unilateral myopia, cataract, and monocular aphakia. He says,[17] "Each time the difference in refraction exceeded two diopters, a visual alternation, an actual strabismus existed before correction." I agree with this view.

In these cases, the convergence function is apparently easily suspended (a lesson learned during life) and the eyes assume the position of rest without regard to the error of refraction present in the fixing eye. This position of rest is the anatomic position of rest as modified by years of activity of the muscles and the degree of suspension of the convergence function.

In the anisometropic type of strabismus the exciting factor may be the anisometropia itself. The images may be so unlike in the two eyes that the need for convergence does not arise. The convergence impulse then is usually not stimulated to bring the unlike images together. However, if the attempt to bring two dissimilar images together is made the control is poor and may be easily upset. In such borderline cases, the general health may be considered an additional exciting factor in the disturbance of the convergence mechanism, as in some cases in which anatomic asymmetry is the primary factor.

Summary

The present concept of nonparalytic strabismus as a condition in which one or the other of the exciting factors influences the state of activity of the convergence function is not entirely new. It gives a somewhat new approach, however, to the view that the activity (plus or minus) of this function determines changes from the anatomic position of rest of the eyes. This concept is tied closely with the evolution of the convergence function as well as that of the position of the eyes. The fusion faculty in this concept is considered to be normally (not abnormally) weak in the formative years because the faculty and its mechanism are (1) in the process of development in the individual, and (2) are relatively new in the evolutionary life of the species.

Conclusions

A simple classification of nonparalytic strabismus is presented. It attempts to correlate the basic physiologic principles involved with types of strabismus found.

The primary exciting factors in the production of nonparalytic strabismus are:

1. The general physical and mental health of the individual.

2. Inequality in the visual efficiency of the two eyes.
3. Mechanical conditions (position of the eyes, abnormal muscle lengths, and so forth).

Secondary predisposing factors, in order of importance, are:

1. The condition of the convergence function.
2. The errors of refraction.
3. The accommodation.

Other factors requiring consideration in analysis and treatment are the sequelae, which are chiefly:

1. Amblyopia of the active suppression type.
2. Structural muscle changes.
3. Disturbed function of the fusion faculty.

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BINASAL HEMIANOPSIA*

Report of two cases

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Of the hemianopsias in the anomalies of the visual fields, binasal hemianopsia is regarded as the most complex in the correlation of its clinical manifestations to that of its etiology which, in many cases, has been vague and at times not too well ascertained. It is the rarest of the hemianopsias. To date only about 147 cases have been reported in the literature since von Graefe published the first case in 1858. In the majority of reported cases, the origin is considered to be vascular, only 53 cases being caused by tumors. Since the two cases presented, in this paper are of tumor origin, they will be presented immediately.

Case reports

Case 1 (181130)

History. A right-handed, 28-year-old, white man was admitted on July 26, 1947, to the neurosurgical department under the service of Dr. Robert A. Groff. He had been in good health until about one year ago when he noted he was walking lamely, but was unable to describe the nature of his lameness or the disability involved.

Seven months ago he noticed the onset of right frontoparietal headaches, usually more severe in the early morning and intermittent in occurrence. For the past six months he had repeated episodes of collapse, heralded by weakness of the body and sudden collapse of the legs. These attacks were of several minutes' duration and occurred about twice daily. They were occasionally warded off by sitting down. There were no periods of unconsciousness, convulsions, incontinence of urine or feces. Headaches were frequently accompanied by nausea but without vomiting. No sensory alternations or hemiparesis had been noted.

For the past two months there had been a progressive blurring of the vision, being greater in the right eye. Three weeks prior to admission to the hospital, the patient had been treated with phenobarbital, which had resulted in a marked decrease in frequency of the collapsing episodes.

Systemic review. Systems were all negative except those of head, eyes, and neurologic, as noted in the history.

Physical examination. Temperature, 99°F. Pulse, 90. Respiration, 20. Blood pressure, 122/82 mm. Hg. Ears, nose, and throat: normal; neck, chest, cardiovascular: normal; abdomen, genitalia: negative.

Eye examination. Exophthalmos: O.D., 18 mm.; O.S., 17 mm. (Hertel). This exophthalmos has been progressive for the past two months. No ptosis or nystagmus. Extracular muscles, normal and full. Tension: O.D., 19 mm. Hg.; O.S., 18 mm. Hg. (Schiøtz). Vision: O.D., 6/15; O.S., 6/15. Lids and lacrimal apparatus, normal. Conjunctiva, normal; sclera, normal; cornea, clear. Corneal sensitivity, present and equal. Pupils: central, equally react to light and accommodation, and consensual. Anterior chambers, normal and clear. Lenses and vitreous, clear. Fundi, disc margins were indistinct, color was pale. There was a bilateral papilledema: O.D., 2 diopters; O.S., 3 diopters elevation. Blood vessels were markedly engorged, tortuous, undulating, and occasionally lost to view. Over the right

* From the Department of Ophthalmology, Graduate Hospital of the University of Pennsylvania. Read before the Philadelphia County Medical Society, Section on Ophthalmology, February 5, 1948.

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disc were two small, fresh, superficial hemorrhages; none were noted in left eye. The left disc was covered with a yellowish-white exudate. Visual fields showed contraction of field and binasal hemianopsia.

Neurologic examination revealed: (1) Cranial nerves normal except optic; (2) definite left hemiparesis; (3) gait was lame with dragging of left leg and arm; (4) tendon reflexes suggestively increased on the left, but not hyperactive; no clonus; (5) Hoffmann present on left. Babinski suggestive.

Laboratory data. Other than a secondary anemia and white blood count of 12,100, all findings were normal. Wassermann was negative. X-ray studies of skull were normal.

Examination by means of ventriculogram showed a moderate shift of the ventricular system to the left with deformity and encroachment upon the anterior horns of both ventricles. Increased vascular markings of the calvarium were noted in the right frontoparietal region. The findings were those of a large mass lesion in the right frontoparietal region.

Operation. On July 30, 1947, the patient was operated and a large, cystic astrocytoma was found in the right frontal lobe which extended to the parietal area. The entire right frontal lobe was removed, which accounted for approximately two thirds of the solid portion of the tumor. The optic chiasma and right olfactory nerve were visualized and, although not directly involved by the tumor, a number of fibrous bands extended to and over the region of the chiasma. This tissue, with the increased pressure in the region of the chiasma, is the probable etiologic factor for the ophthalmic findings.

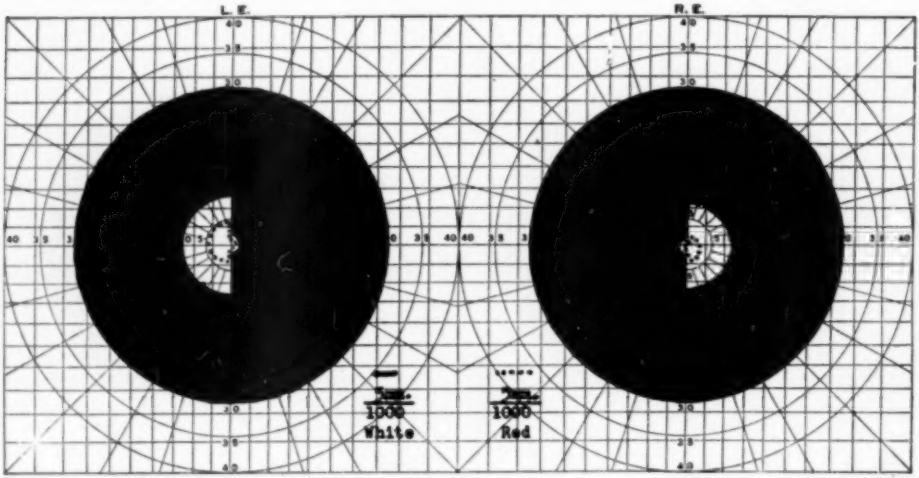

Fig. 1-a (Raiford). *Case 1.* July 26, 1947. Vision: O.D., 6/15. O.S., 6/15. Tension: O.D., 17 mm. Hg; O.S., 19 mm. Hg (Schiøtz).

Outcome. The patient had an uneventful recovery from the operation with a gradual reduction of the exophthalmos, and on discharge from the hospital, August 11, 1947, the papilledema had subsided to one diopter of elevation in each eye.

The patient was seen in the clinic on October 15, 1947, and central fields and fundu-

scopic examinations were taken and on monthly intervals thereafter.

The fields were slightly larger and the papilledema had subsided with pallor of both discs, showing all manifestations of a secondary optic atrophy. The last examination and visual fields, done on January 15, 1948, were contracted and concentric and did not show any hemianopsia. The papilledema was not present. A secondary optic atrophy was present on funduscopic examination.

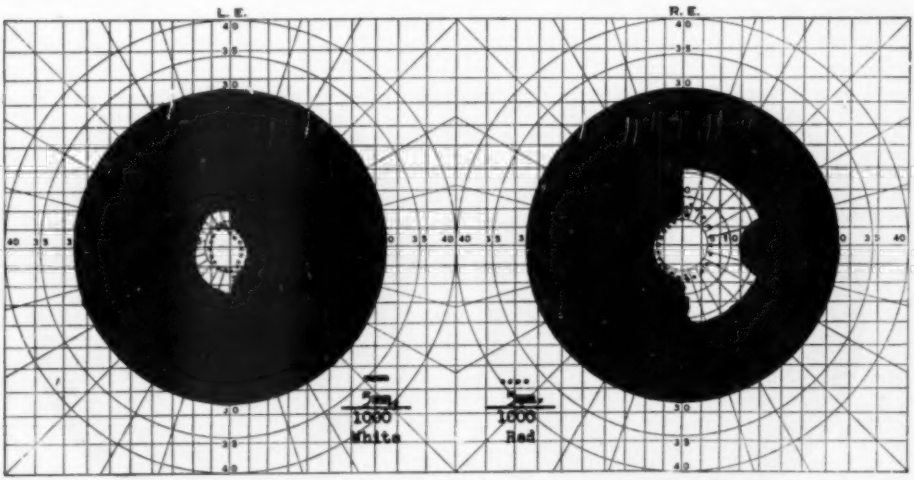

Fig. 1-b (Raiford). *Case 1.* September 12, 1947. Vision: O.D., 6/12. O.S., 6/12. Tension: O.D., 19 mm. Hg; O.S., 19 mm. Hg (Schiøtz).

CASE 2 (182576)

History. A 55-year-old, single white man was admitted November 2, 1947, to the department of neurology on the service of Dr. Joseph C. Yaskin for study because of dizziness of two years' duration. His past medical history is not contributory except to note that he had a discharging right ear some years ago, which has not discharged for a number of years not remembered by the patient. He stated that about two months ago following a "cold," not accompanied by a running nose or ears, he developed dizziness.

Since that time he has complained of inability to walk, with constant veering to the right. He had had diplopia on several occasions. Ringing in the right ear had been present for many years. The tinnitus had not increased recently or varied in any degree. There was no history of headache, nausea, or vomiting, and probably no weight loss. The patient has lived in this country since the age of 12 years, except for a period from 1912 to 1916, when he again lived in southeastern Europe.

Objective examination. On admission the patient was well oriented, intelligent, cooperative, with slight pallor. Blood pressure, 100/70 mm. Hg. Somatic examination was normal.

Neurologic abnormalities. On admission, these neurologic abnormalities were present: (1) Horizontal nystagmus, more marked when looking to the left; (2) questionable left central facial palsy, which was apparent on positional innervation; (3) he held his neck stiff and veered to the right on walking; (4) marked adiadokocinesis of the left upper extremity; (5) generalized

increased tendon reflexes, more marked on the right. Both knee jerks were pendulous.

Laboratory data. Several complete blood counts were all within normal limits. Urinalysis was negative. A fasting blood sugar was 85 mg. percent. Blood urea nitrogen was 12 mg. percent. The Wassermann examination was reported weakly positive, but four later tests were all negative. Electrocardiograph was normal.

X-ray examination on November 3, 1947, revealed the skull to be essentially negative. Examination of the chest showed a paramediastinal mass on the right side that appeared to be separate from the aortic shadow. The possibility of a brochogenic carcinoma was strongly suspected. In an attempt to determine the etiology of the mass, bronchoscopic examinations were performed. The bronchi on both sides, including the upper and lower main stems, were patent and showed no abnormalities.

A Barany test was indicative of a posterior fossa lesion as well as a hearing loss of the right ear of 12.8 percent and of the left ear of 8 percent. This preservation of hearing was felt sufficient to explain the diagnosis of a cerebellar pontin-angle tumor.

Ophthalmic consultation verified the nystagmus noted on neurologic examination. Uncorrected vision was: O.D., 6/15; O.S., 6/15. Corrected vision was: O.D., 6/9; O.S., 6/9. Tension was O.D., 19 mm. Hg; O.S., 19 mm. Hg (Schiøtz). No exophthalmos nor ptosis was present. Palpebral fissures: O.D., 8 mm.; O.S. 8 mm. Lids and conjunctiva were normal; extraocular muscles, normal and full; scleral and cornea, normal; corneal sensitivity, present and equal. Pupils: central, equal reaction to light and accommodation, consensual. Anterior chambers, normal and clear. Vitreous: O.D., clear; O.S., asteroid hyalitis. Fundi, discs were round, margins clearly outlined, no elevations. Blood vessels were normal. Maculas and periphery were clear with no hemorrhages nor exudates.

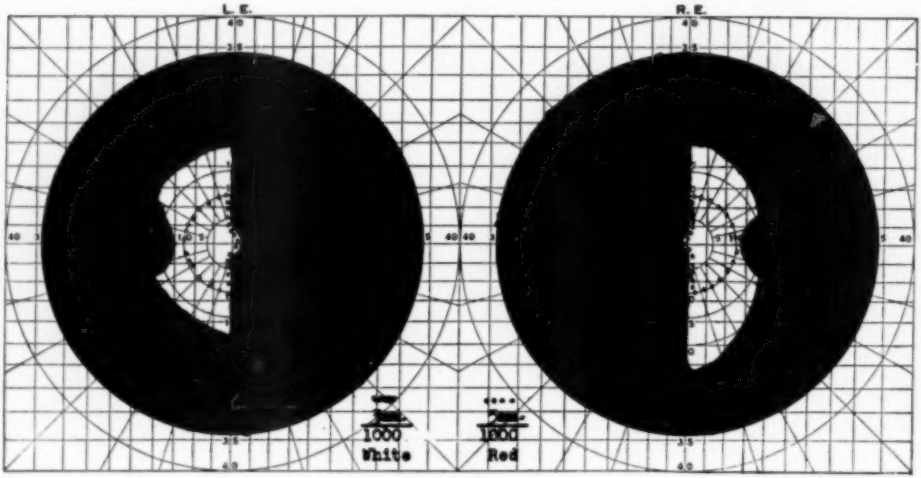

Fig. 2-a (Raiford). *Case 2.* November 11, 1947. Vision (corrected): O.D., 6/9; O.S., 6/9. Tension: O.D., 19 mm. Hg; O.S., 19 mm. Hg (Schiøtz).

Visual fields revealed a binasal hemianopsia, and it was felt that it could only be explained on the basis of a mass lesion pressing laterally on the chiasma, and that another lesion in addition to the pulmonary

and posterior fossa lesion existed.

Treatment. It was decided that this mediastinal mass lesion probably represented a tumor of the lymphoblastoma series and that the patient should have the benefit of a trial course of X-ray therapy. He was treated with 800 r. to each anterior and posterior port. X-ray reëvaluation on November 12th showed that the previously described right paramediastinal mass had decreased 1 cm. since November 3rd.

It was, therefore, felt that the patient had a moderately radiosensitive neoplastic mass and X-ray therapy should be continued. In the course of the next five weeks, the patient received a total of 2,400 r. to each of the anterior and posterior mediastinal ports. In addition, to the posterior fossa to strike the chiasma region, a total of 6,000 r. with three ports of 2,000 r. each. Repeated X-ray studies of the chest on December 5th and December 10th showed a full 1 cm. decrease in the size of the mediastinal mass.

Visual fields were again taken on December 12, 1947. Corrected vision was: O.D., 6/6; O.S., 6/6. The fields showed marked improvement. External and funduscopic examinations were essentially negative at this time.

The course of X-ray therapy was completed on December 20, 1947, and the patient was discharged from the hospital to return for monthly check-up examinations.

Comment. (1) No positive diagnosis can be made; (2) a sternal-marrow aspiration was normal for both red and white blood count; (3) however, one is justified in making a diagnosis of lymphoblastoma from the clinical course and, especially, from the response to X-ray therapy.

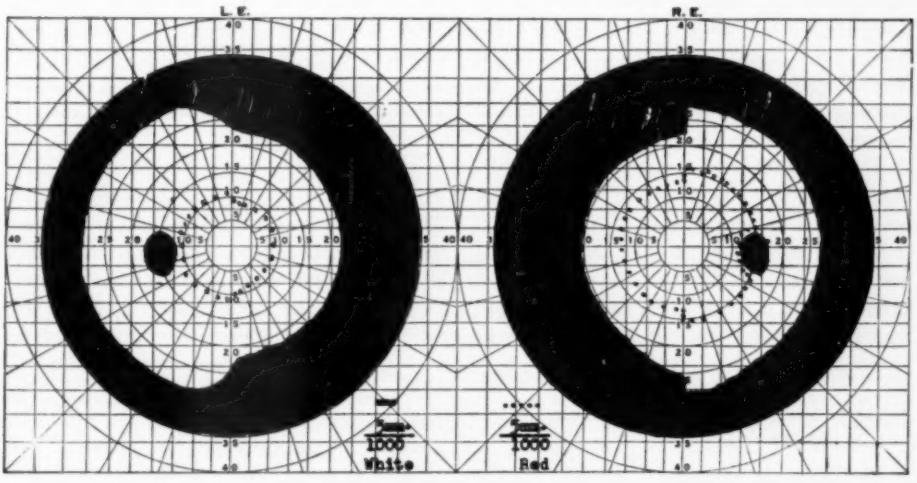

Fig. 2-b (Raiford). *Case 2.* Fields taken December 12, 1947, following a course of X-ray therapy. Vision (corrected): O.D., 6/6; O.S., 6/6.

Discussion

A classification of lesions leading to the formation of binasal hemianopsia was made by Lutz (1928), Miranda (1943), and Francois (1945), the latter having a total of 53 cases of tumor origin of the 142 reviewed.

The etiologic factors bringing about a binasal hemianopsia may be grouped under three main considerations:

A. Extension by the third ventricle

B. Impairment of the chiasma vascular supply

C. Direct pressure by a mass lesion

A. Extension by the third ventricle

This etiologic evidence was projected by Cushing and Walker (1912) in their report of a series of 300 cases. In their review, they stated that 5 to 6 percent of the tumor cases manifested binasal hemianopsia. They considered that the main factor in the creation of this visual defect was a forward projection by the third ventricle on the chiasma area, causing it to develop lateral pressure against the internal carotid arteries. By impairing the uncrossed fibers of the chiasma, this direct pressure would result in a binasal hemianopsia.

Evaluating this mode of action, it would seem to present a rather unlikely chain of events, and a number of writers have found it difficult to give full credence to its part in establishing a binasal hemianopsia.

B. Impairment of the chiasma vascular supply

The chiasma is mainly supplied by the minute blood vessels, arising from the internal carotid, which insert themselves for the main in a lateral portion and inferiorly. The anterior cerebral artery, which sends minute branches superiorly, is next in importance. Vail and Abbie state that the anterior communicating artery also gives off some vessels.

From dissections which I made of the optic tract and radiations* of eight brains, it appeared that the vascular supply of the area of the chiasma was derived from the internal carotid and the anterior and middle cerebral arteries. The anterior communicating artery did not contribute any vessels as far as could be determined in these dissections. These minute vessels penetrate the pia and pass into the nerve tissue and form the septial network of the nerve. These networks are not closed, but have small openings and are separated from the nerve bundles by glial fibers, the means of regulating the metabolism.

Any condition that brings about an impairment of this minute vascular supply would seem to be a more logical etiologic factor than gross pressure of sclerotic internal carotids, which, because of its direct influence upon the chiasma itself, has always been given precedence in the etiology of binasal hemianopsia.

The findings in Case 1 herein presented would tend to bear out this deduction. The direct action of fibrosis around the chiasma would appear to have interferred with this small vascular supply from the internal carotid, anterior, and middle cerebral arteries. The monthly follow-up studies in Case 1 tend to substantiate this theory. When last studied on January 15, 1948, the fields were contracted and circular and changes of the nerve head were those of a greater secondary optic atrophy.

C. Direct pressure by a mass lesion

It is considered that, in order to establish a binasal hemianopsia, a mass lesion must be pressing from each side of the chiasma; or a horseshoe-shaped lesion is acting in the manner of a carpenter's wood clamp. A mass lesion could also act by pressing upon one side of the chiasma, forcing the opposite part of the chiasma against the internal carotid artery. One must again consider that it is impairment of the blood supply to the chiasma and probably not a direct pressure per se of the tumor which produces binasal hemianopsia.

Impairment of the blood supply causes anoxemia and, thereby, prevents conduction by the nerve fibers. One finds a marked improvement, or nearly complete recovery, in the fields within several days after the

* Dissections of optic tract and radiations, Department of Neuroanatomy, Graduate School of Medicine, University of Pennsylvania. March-May, 1947.

tumor pressure has been removed in early cases. This would seem to point to a disturbance of nutrition in the region of the chiasma.

Case 2 of this report tends to emphasize the factor of direct pressure. Improvement of the visual fields following X-ray therapy leads one to consider that the lesion had greatly impaired the nutrition of the chiasma region. Although no radiologic evidence of an intracranial lesion existed, all signs and symptoms appeared to indicate its presence.

Summary

In the two cases presented, the lesion in Case 1 was a primary lesion; in Case 2, the intracranial lesion was apparently a metastasis from the lung.

19th and Lombard Streets (46).

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ANTHRAX OF THE EYE*

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Anthrax is a disease of the herbivora, but man is susceptible to it and acquires it either from contact with the infected animal or with the parts or refuse from the cadaver. It is most frequently found in sheep and cattle, but not infrequently in horses, hogs, and goats. The disease is especially prevalent in Europe, but no country in the world is immune from it.

The bacillus anthracis is of historic interest because it was the first microörganism proved to be the specific cause of an infectious disease. The bacillus was first observed in the blood of infected animals by Polland in 1849. Davaine first produced experimental anthrax in 1863, but the final proof came when Koch made it possible to isolate the bacillus on artificial media. Pasteur was able to produce active immunity by the use of attenuated cultures, and this method was used on many of the animals in France. The bacillus is aerobic, but is anaerobic in the spore state. It is a large gram-positive bacillus.

Types of anthrax

There are three types of this disease—malignant pustule, malignant edema, and the internal type which may be further divided into the pulmonary, intestinal, and meningitic forms. The incubation period in all forms is from 12 to 36 hours.

The malignant pustule begins with an initial, raised, red lesion that quickly is surrounded by induration and edema. The center becomes a vesicle, and then becomes gangrenous with the formation of a black center and surrounding vesicles.

The malignant anthrax edema, so adequately described by Ross and Shipman, is characterized by marked edema without a pustule. The most usual place for this is about the eyes, but may be found about the mouth. It is rare (Gold reported 60 cases of anthrax in which there were no cases of malignant edema) but, in the group of cases reported by Ross and Shipman, malignant anthrax was found in 30 percent of the eye cases and 2 percent of the whole series. The edema is marked and brawny, pitting on pressure, and is painless. It spreads rapidly and, as in Shipman's case, may spread from the eye down over the chest.

Constitutionally the patient is not very sick. He may have some headache and nausea, and on the 2nd, 3rd, and 4th days, there may be some fever. This is felt to be as much a reaction to the treatment as to the disease.

As the edema progresses, there is usually a sloughing of the skin of the lids. Anthrax bacilli may be found in the serum beneath these sloughs. When treated with penicillin, it is difficult to get a positive smear. In the case reported, none was obtained.

In the internal types, the mode of infection differs. In the pulmonary type, generally found in wool workers, the anthrax spores are breathed into the lungs. This type of the disease has a high mortality. The intestinal type is caused by ingested spores. This is the method by which animals are infected, but is a rare mode of infection in man.

Incidence of anthrax

Due to the fact that for years there have been many leather industries throughout southern New Jersey, there has been a moderate amount of anthrax in this vicinity. One of us (J. C. L.) has treated at the Camden Municipal Hospital 90 cases of anthrax since 1924.

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* Read before the Ophthalmic Club of Philadelphia.

† Medical director, Camden Municipal Hospital.

Of these 90 cases, there were 7 cases involving the eyes, 2 of which were so-called malignant edema and 5 malignant pustule. Of the eye cases there were no deaths. There were 3 deaths among the 90 cases. These deaths were caused by fulminating septicemia and, in one case, meningitis which terminated fatally 6 hours after admission.

The most frequent sites of the lesion in these cases were on the arm, 26; neck, 17; cheek, 17; and eye, 7. There was 1 pulmonary type, 2 on the forehead, 4 on the shoulder, 1 on the back, 1 on the nose, 1 on the mouth, 2 on the abdomen, 4 on the hands, 2 on the lips, 4 on the thigh and legs, and 1 meningitic case.

It can readily be understood that since many of these cases occur in persons who carry leather, the place usually infected would be about the cheek, shoulder, and neck. At times the bacillus would be rubbed into the eyes. In this series of 90 cases, it was interesting to note that only 3 cases from outside of leather and wool industry were referred to the Camden Municipal Hospital.

One of these cases was that of a waitress in whom anthrax was caused by wearing a cheap piece of fur. This was also one of the ocular cases. There was a lesion 2 cm. in diameter, with a black center surrounded by vesicles and edema, present at the outer angle of the right eye.

There were also two cases which occurred on farms where the refuse from the wool factories was used as fertilizer.

The diagnosis has not been too difficult in most of these cases, due to the fact that many of these patients come from factories where everyone is suspicious of anthrax. Very often these cases are diagnosed by the nurse and sent to the hospital for treatment. In fact, the case to be reported was diagnosed by the nurse and sent to the Municipal Hospital where Dr. Lovett verified the diagnosis.

Ocular manifestations

Since anthrax involving the eye may at some time be seen by ophthalmologists, it is well for us to keep in mind the differential diagnosis. When there is a definite pustule, the black center with surrounding vesicles should make one suspicious of anthrax. When a red pustule is present in a leather worker, it must be proved not to be anthrax. A smear will verify the diagnosis.

Atkinson felt that it should be differentiated from a basal-cell carcinoma mostly because of the black necrotic centers which form at times in these carcinomatous lesions. Usually, however, in the carcinomatous lesion, there is not the marked edema that is associated with anthrax. With the necrotic lesion in anthrax, pressure exudes fluid which, if a smear is taken, will reveal the anthrax bacillus.

In tularemia, there are ulcers of the conjunctiva with preauricular adenopathy. In these cases, of course, anthrax bacillus would not be found and there would be a positive agglutination test for tularemia.

The malignant edema type of anthrax can be differentiated from the edema of the lids caused by cellulitis by the fact that it is painless. In inflammatory lesions about the eye, an infection of the lacrimal sac, chalazion, hordeolum, or infected sinuses may also be located as the source.

It might be somewhat more difficult to differentiate the anthrax edema from the edema associated with trichinosis. It is felt that anthrax edema is much more marked than that found in trichinosis. The history of the eating of raw pork is also present in trichinosis, and the differential blood count shows a high degree of eosinophilia. A biopsy of the muscle should show the characteristic cysts of the larva of trichinosis.

Angioneurotic edema may be differentiated by the history of recurrent attacks of edema at different sites of the body, allergic history, and the fact that the edema, while painless, will not show any induration.

In malignant edema of anthrax the edema is more marked. Generally a positive anthrax smear cannot be found but, if there is crusting of the lids, smears taken from this portion may reveal the anthrax bacillus. Erysipelas may be diagnosed by the redness of the swelling and the line of demarcation.

Treatment of anthrax

The treatment of this disease has undergone a marked change during the last seven years. Before the discovery of the sulfonamides and penicillin, antianthrax serum was used. While this was efficacious in curing the disease, often the serum sickness was worse than the disease itelf. All of the patients treated at the Camden Municipal Hospital by serum had serum sickness. Since antianthrax serum is no longer used, treatment by this method will not be discussed. Neoarsphenamine has been used, but both Lovett and Gold feel it is of little value, while Smythe felt that it was the treatment of choice. With the introduction of sulfonamides, a marked advance was made in the treatment of this disease. One of us (J. C. L.) has used sulfadiazine, giving 5 gm. intravenously at first, then 2 gm. every three hours. Usually it requires from 21 to 94 gm. to control the disease.

At the present time, penicillin is used almost exclusively. It is given in doses of 40,000 units every hour until the patient responds; then 12,000 to 15,000 units every two hours.

It would seem that no matter which treatment is used the patient goes through about the same stages. The lesion increases in size for 2 to 4 days, with the edema becoming more marked. Although it may appear that the patient is not responding, generally on the fourth day the edema will begin to subside. Ellingson made this same observation.

If the edema does not begin to clear up, then sulfadiazine is used in conjunction with the penicillin. Sulfadiazine and penicillin seem to have about the same degree of efficacy but, since there is always the danger of kidney damage and damage to the hematopoetic system with the use of sulfadiazine, penicillin is the drug of choice. Local treatment should consist of no manipulation, application of some local antiseptic, and a sterile dressing.

Prevention of anthrax

Prevention of anthrax consists of proper treatment of the hides to kill the spores. Most of the workers are infected when they handle the hides. These men change their street clothes before working. After work they take a shower before putting on their street clothes. They are advised to shave at night after work. They are told to report to the medical dispensary for all cuts, boils, and swelling. Placards showing the three different stages of the malignant pustule are posted in prominent places.

Malignant edema of the left eye

Report of a case

History. The patient, a worker in the leather industry, was admitted to the Camden Municipal Hospital on the morning of February 12, 1947 (referred by Dr. Paul Mecray, Jr.). He had been working with goat skins. He gave a history of having scratched the face near the left eye 10 weeks before. The lower lid of the left eye started to swell on February 11th. The swelling had increased markedly by the next morning, extending down over the cheek.

Examination. On admission to hospital, the lower lid was very edematous. There was considerable redness and a moderate amount of swelling of the left cheek. There was no tenderness or pain. Both lids were inflamed. There was a serous secretion. Smears taken on that day were negative and remained negative except for some contaminating Staphylococcus albus. Blood cultures were negative.

Course. On the afternoon of February

12th, the edema had increased a great deal, and the eye was closed. The edema had also spread to the forehead and temple. On February 13th, it remained about the same. On February 14th, both lids were more swollen, and the skin of the lower lid was black. There was edema of the forehead and side of the face, and the lower lid began to look as if it would slough.

On February 15th, the edema was less. On February 16th, the edema of the cheek and forehead had cleared up. The lower lid showed a gangrenous area. On February 18th, there was still marked edema of the eyelids, but the patient was able to open the eyes. On February 19th, the eye could be opened, and there was a black eschar of the lower lid.

The patient was discharged from the hospital on February 27, 1947, at which time the eye could be opened. There was a black crust over the skin of the lower lid. While in the hospital, the temperature was normal except for the 2nd, 3rd, and 4th days at which time it went to 103°F., to descend to normal by lysis on February 17th. The patient on admission was ordered 30,000 units of penicillin every four hours. He received a total of 2,500,000 units of penicillin. Local treatment consisted of ice compresses, boric acid ointment to the lower lid, and penicillin drops.

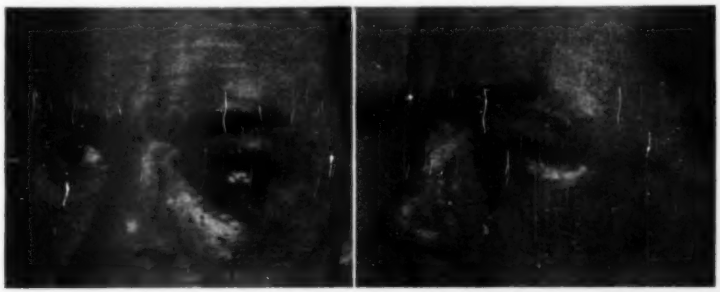

Fig. 1 (Barnshaw and Lovett). These pictures, taken on February 15, 1947, the third day of the infection, show marked edema and the beginning gangrenous area.

Fig. 2 (Barnshaw and Lovett). In the fourth week of the infection, there is an eschar and raw area of the lower lid.

Outcome. On March 1, 1947, vision was practically normal in each eye. There was a large eschar of the lower left lid which extended along the entire lid margin.

The lesion was 4 cm. in length and 1 cm. at the widest portion. At this time, there was a beginning ectropion of the lower lid. The eschar slowly loosened, leaving a raw area. A marked ectropion developed. A tarsorrhaphy was performed on March 17th.

After the removal of the sutures on March 28th, the ectropion was felt to be slightly less. On April 3rd, Snellen sutures were placed in an unsuccessful attempt to relieve the ectropion. The patient was admitted to Cooper Hospital on May 8th, and on May 9th, a plastic operation of the left lower lid was performed.

Fig. 3 (Barnshaw and Lovett). January 10, 1948. Appearance after the skin graft and repair of ectropion. Sagging of the lower lid is present.

At the operation, a full-thickness graft was taken from the upper right lid and implanted in the lower left lid after removal of the cicatrix. A tarsorrhaphy was performed at this time. The skin graft took successfully, but even following this there was a moderate ectropion.

On June 7th, four cautery punctures were placed on the conjunctival surface of the left lower lid. On July 8th, the ectropion had completely disappeared. There was only a slight amount of sagging of the lower lid. On January 8, 1948, there was no ectropion of the lower lid, but there was some sagging due to loss of power of the orbicularis. There were several cilia which rubbed against the cornea at the site of the tarsorrhaphies. These cilia were removed by electrolysis.

Conclusion

Anthrax has been discussed. The frequency of the disease at the Camden Municipal Hospital has been reported. Special emphasis has been placed on the ocular manifestations. A case of malignant edema has been reported which had a marked cicatricial ectropion as a sequela. The method of treatment of ectropion is given.

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REFRACTIVE TREATMENT OF ASTHENOPIA*

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There is a group of eye sufferers whose eyes show insufficient apparent abnormality to account for such distress. They are seen less frequently today than in the past, because such conditions as hypermetropia, astigmatism, heterophoria, and the like are better treated. One can imagine the perplexity years ago when a patient came in with inability to do near work, yet could read perfectly at distance and near. Hypermetropia went untreated long after glasses for myopia and presbyopia were in common use. The only treatment known for hypermetropia was rest from near work.

Although we have made progress in the treatment of asthenopia, the problem is still with us. Patients still drift from one doctor to another in the hope of relief, or resign themselves to life in a soft-lighted room avoiding near use of the eyes. It is difficult in a busy office to give such a patient sufficient time, and too often the patient is prematurely labelled "functional." At the present state of knowledge, it cannot be said that any case of asthenopia is functional. It is admission of failure to give nonspecific treatment.

The patient might be referred elsewhere but for the tendency to consider refraction an insignificant branch of ophthalmology. One would as soon refer a patient with a stye.

In this paper, a procedure for handling difficult refractive patients is submitted, not with any claim to originality or finality, but in the hope that readers will find something useful in it.

ROUTINE PROCEDURE

On the first visit, the problem is surveyed. Systemic diseases and foci of infection are sought. A careful routine examination of the eyes is made to rule out such conditions as chronic uveitis or keratitis. Refractive changes are expected in such conditions as diabetes, sulfonamide administration, metabolic disturbances of the lens, cornea, or sclera, pressure on the globe as from a chalazion, injuries, foreign bodies, or ulceration of the cornea.

When the patient requests only a refraction, it is easy to abbreviate the general examination, and overlook contributing disease. If there is insufficient time, one should make a future appointment to permit attention to every detail. Patients with asthenopia often require all the knowledge and skill possible, and should pay a higher fee.

REFRACTIVE PROCEDURE

The refractive procedure is as follows:

I. Noncycloplegic refraction and motility studies.
   a. Visual acuity without and with old glasses, distance and near.
   b. Prescription of old glasses on the lensometer.
   c. Retinoscopy with trial frame, sphere, cylinder, and axis determined.
   d. Keratometry if retinoscopy is inconclusive.
   e. Binocular noncycloplegic subjective refraction, using "fog," dials, and crossed cylinders.
   f. Binocular tests for astigmatism at near.
   g. Cyclodamia affected by amblyopia and dominance.
   h. Phoria studies using the Maddox rod.
   i. Amplitude of accommodation and convergence near point.
   j. Ductions, versions, diplopia fields.

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II. Cycloplegic refraction.
   a. Residual accommodation.
   b. Determination of new prescription.
      1. The "post" test.
      2. Temporary glasses or clip-ons.
      3. Undercorrection and spherical equivalents.
      4. Precision lenses, cornea to lens distance.
      5. Monocular occlusion.
      6. Anisometropia and aniseikonia.

Noncycloplegic refraction and motility studies

Visual acuity

The test chart for refraction should be illuminated at about 20 foot-candles, with the entire room at about 5 foot-candles. In manifest refraction under dim illumination, changes of refraction due to aberration may occur if the pupil becomes larger than about 4.5 mm. If the light is too bright, the pupils remain small, and the depth of focus is so great that the discrimination of small differences in astigmatic correction is poor.

The phoropter with its banks of lenses is a convenience in ordinary refraction, and will save the refractionist time. It is notably absent in teaching institutions not only because of its cost, but because of its disadvantages in use on difficult cases. The lens housing is so large that it is difficult to be sure that the cornea-lens distance is equal at all times, and that the visual lines correspond to the optical centers of the lenses.

In spite of the head rest, few patients remain aligned properly throughout the procedure. Rotations of 5 degrees are difficult to detect because the whole face is covered. Facial expression during refraction is obscured. The patient may be stimulated to accommodate because of the long narrow tubes he must look through, and because of the nearby mass of machinery.

Worst of all, the mechanism will not move to align the lenses in convergence and deorsumvergence in the reading position. Near tests are done without the eyes lowered, changing the phoria involved. With trial frame and loose lenses, the "tube" to be looked through is only about 1 cm. compared with about 7 cm. in the phoropter.

With the trial frame, phoria due to anisometropia can be measured in the reading position. The visual lines can cut the lenses 5 mm. below center, instead of at center as in the phoropter. Precision trial-case lenses are preferred, but it would be helpful to have a wide enough diameter test lens so that vertical imbalance due to anisometropia could be measured in the reading position.

Lensometer

With patients in whom the axis and amount of cylinder is important, it is a great advantage to have a lensometer in the office. It is important to know what the patient has been trying to wear, and it is important to know how near the optical manufacturer approximates your prescription. The tolerances allowed vary from 0.06 to 0.25 diopters.

Retinoscopy

Place the trial frame on the patient's face so that the centers of lenses fall on the visual line with the eyes on the 6-meter target. This may make the frame slant when compared to the position of brows or lids. If a lens must be decentered because of facial asymmetry, the optician takes it for granted that cylinder axes were measured with the lenses centered on the eyes, not the brows.

Noncycloplegic retinoscopy, like refraction, requires "fogging." Blur due to excess plus sphere before an eye tends to lower the accommodation level, because only by lowering can the retinal image become more distinct.

The level of accommodation wavers physiologically, and involuntary reflexes select the "zig" or "zag" found to be best at the distance fixed.

Both eyes must be "fogged" because if one eye is stimulated to accommodate, the other follows. A 6-meter target distance without mirror is essential for retinoscopy and refraction, because eyes will never relax to 6 meters in a 4-meter refraction room.

The technique of retinoscopy must be cultivated to a high degree if one is to be able to test all patients. In children it is absolutely essential, and many adults have such poor visual discrimination that retinoscopy is more accurate than their answers. A common mistake is to tell the patient to observe the distant "muscle" light, and then not ensure that he does. The pupil gets smaller, and the reflex becomes imperfect the instant the patient loses distant fixation.

In children, keep fixation by constant questions, "How many lights are there, one or two? Is the light round? Is it square?" And so forth. Children fix better on a light in slight motion, or blinking off and on. To check the cylinder in small children, retinoscopy may be performed with the patient fixing fingers on the doctor's forehead, again with questions. Accommodation (even with cycloplegic), depth of focus, inexact fixation, and other factors make estimation of spherical correction at near useless.

Retinoscopy should be as near as possible to the visual axis on the disc side. If the arrangement of the room permits, it is good to retinoscope right eyes with the right eye, and left eyes with the left. If the doctor stands to refract, the fixation light should be near the ceiling. The room illumination should be about 0.5 foot-candles. Perfect darkness might dissociate the eyes or permit cyclotorsion.

Working distance from retinoscope to eye should be known. Some refractionists take pains to stay exactly at one meter, so that the deduction from neutrality is exactly one diopter. The deduction increases rapidly as one gets nearer, so theoretically the precision is greater at a greater distance. With this in mind, some work at 2 meters. It is quite evident, however, that the visual angle is so small at this distance that the doctor can scarcely see the pupil. The reflex is so much sharper and more definite at one meter or less, that it is absurd to back up beyond arm's length. The arm stays constant, so precision is assured. It is often necessary in children to hold the lenses in the hand for retinoscopy, or hold the ill-fitting frame in alignment while testing, so one might as well make that working distance a habit.

Avoid a retinoscope with a central shadow in the beam. The round, slightly diverging beam is adequate, although the streak retinoscope has certain advantages. Only the round diverging beam retinoscope will be discussed here.

When the patient has 1.5-mm. pupils, lens or vitreous or corneal opacities or irregularities, it is helpful to move closer to the patient, and try to see a "with" movement. Contrary to earlier beliefs, retinoscopy is more satisfactory with a 3.5-mm. pupil than it is with one 8 mm. This is because it is easier to select the significant central reflex and avoid the distraction of peripheral reflexes. Some use an artificial pupil, but it is a nuisance. Some use paredrine routinely in elderly patients, which acts in 20 minutes and is useful to change a pinhole to a 4-mm. pupil.

Precision in retinoscopy in most patients should be plus or minus 0.25 diopters, both sphere and cylinder. Axis can be determined within 5 degrees even with the round beam. If your perception is better than that of the patient, you should be able to see into his eye better than he can see out.

To determine the cylinder by retinoscopy, avoid too close an approach to neutrality, and avoid an "against" reflex altogether. Keep the sphere fixed at about 1.0D. below neutrality (on the "with" side) so that the retinal reflexes move fairly slowly, and the speed in the two meridians can better be compared.

Determine the amount of cylinder at this level by moving the retinoscope beam first along the axis of astigmatism, than 90 degrees away. When the movements of the reflex are equal in the two meridians, change the movement to axis 90° and axis 180° to determine the axis. With the retinoscope beam moving straight up and down, there is a horizontal linear reflex in the pupil perpendicular to the movement of the beam, if the cylinder is correct, regardless of its axis.

Now, move the cylinder off axis in either direction, and observe the skew of the reflex. The horizontal line seen may rotate 30 degrees when as small a cylinder as 0.75D. is off axis 10 degrees, when the movement of the retinoscope beam is kept moving straight up and down. By rotating the cylinder clockwise and counterclockwise, the skew reverses, and the cylinder axis is centered between them and the skew eliminated. On moving the beam horizontally, a similar linear reflex appears perpendicular to the movement, and can be used equally well to determine the axis.

When the cylinder is determined, add some plus sphere until the reflex changes from "with" to a pupil full of light without movement. This is neutrality. To check, move slightly nearer the patient until the balanced "with" movements are seen again. Moving nearer for a moment will save time in estimating changes of sphere in the trial frame.

When the dioptric value of the arm's length used in retinoscopy is removed from the trial frame (about 1.5D.), the patient should be able to read the 6/6 line. It gives the patient confidence to observe that work with the retinoscope alone gives an accurate prescription.

Keratometry

For patients in whom retinoscopy is unsatisfactory, the keratometer and astigmatic dials are used to determine the astigmatism. The keratometer is ideal for patients with aphakia, and is very useful in children. The technique will not be discussed, here.

Subjective refraction

Replace about plus 1.25D. sph. as an occluder over the eye not to be tested to maintain binocular conditions. Determine if plus sphere 0.12D. or 0.25D. can be added to the other eye without blurring. Throughout the test, make sure that all image meridians are preretinal by having in the trial frame all the plus sphere the patient will accept.

Likewise, never remove plus sphere or cylinder temporarily without having the patient close both eyes for the change, because he will immediately accommodate, and may take some time to relax again. Never add minus sphere or cylinder unless it is certain that the retinal image will not be pushed postretinal to stimulate accommodation.

In subjective tests for cylinder amount with minus cylinders, before increasing the cylinder, add to the sphere an amount of plus equal to half the value of the cylinder. If plus cylinders are used, follow the cylinder increase with a decrease in sphere of equivalent amount, if necessary for 6/6 acuity.

One cannot even momentarily remove a plus cylinder from the trial frame without telling the patient to close both eyes, because of the immediate stimulus to accommodate. If the accommodative level is controlled in this way throughout the refraction, it gradually relaxes and the patient accepts more plus sphere.

There is no argument for or against minus cylinders as long as the entire refraction is accomplished without permitting one or both image meridians to go postretinal.

The Jackson crossed cylinder is used first to determine subjectively the amount of astigmatism. The crossed cylinder marked 0.12D. is strong enough for most tests, because it makes a change of 0.25D. in the amount of cylinder. Where the precision is less, as in the reading position, the stronger

0.25D. and 0.5D. may be used. A stronger Jackson crossed cylinder is improvised by placing a plus sphere before the eye to be tested and flipping a minus cylinder to align, then cross, the cylinder in the trial frame. If plus 0.5D. sph. is used, the cylinder should be minus 1.0D.

Place the indicators on the crossed cylinder exactly on the axis of the cylinder in the trial frame, alternating from the white pair to the red pair (or plus sign to the minus sign). If the patient prefers the image seen with the white dots in line with the axis, the cylinder is to be made less minus (more plus). If the red dots are selected, the cylinder is changed toward more minus (less plus).

Flip the crossed cylinder quickly to make comparison of the two possibilities easy. Get a quick decision so there is little opportunity for accommodative changes. The target used most commonly is the 6/7ths line of letters at 6 meters, or a line just legible in either position of the crossed cylinder.

If the patient does much reading, he may have built up a mental set to prefer vertical lines black and horizontal gray, for instance. Therefore, if subjective tests on letters do not agree with the retinoscopic or keratometer findings, one should compare findings on the simple dial with two lines at right angles. The lines are rotated until one falls on the astigmatic axis. Cylinder amount is adjusted until the two lines appear equally black, and the Jackson crossed cylinder is used as a double check. When the red dots (or minus signs) are in the plane of one target line, that line should appear blacker. Patients need coaching to understand this test. More discussion follows.

Subjective adjustment of the cylinder axis is most precise by use of the Jackson crossed cylinder. It is held so that its handle is aligned with the cylinder axis in the trial frame (or 90 degrees from the axis). If the patient sees a blacker more distinct image with the red spots turned one way, a minus cylinder axis should be rotated slightly in that direction until no difference in the two possibilities is reported. If plus cylinders are used, the trial-frame cylinder axis is to be rotated toward the white spot of the crossed cylinder in the position preferred.

There is little use of trying to get closer than plus or minus 2 degrees of the axis, because the trial frame is not that accurately placed before the eyes. Usually the prescription is made to the nearest 5-degree mark on the trial frame. In high astigmatism, all effort should be made to keep the trial frame straight and get the axis within 2 degrees.

Astigmatic dials

It is quite possible that patients can relax the level of accommodation better by fixation on a dial than on test type.

The accepted procedure is as follows: Place increasing plus sphere before the patient's eye until he reports "worse." To this, add about 1.5D. more. Repeat before the other eye. In myopia, add about 1.5D. less minus than the patient desires for best vision. With this "fog" before both eyes and the clock-type dial as a target, gradually reduce the "fog" before one eye until one line on the dial comes into sharp focus. (It moves from image preretinal to retinal. The other spokes are still preretinal.)

Change the clock dial for the dial with two sets of lines at right angles, placed so that one set of lines is in the same meridian said to be blackest on the clock. Rotate the simple dial slightly clockwise and counterclockwise until the position of greatest sharpness and blackness of one line is attained.

This determines the axis in which plus cylinders must be placed, or the axis 90 degrees from which minus cylinders are to be placed to obtain equality of blackness of the two lines. If plus cylinders are used, the sharp image is converted to a blurred one which is matched with the other blurred

one. Precision in comparing the two lines is best, with the lines blurred 0.25D. to 0.5D., the images being kept slightly preretinal.

If minus cylinders are used, the blurred image becomes sharp, but one must add plus sphere during the procedure to ensure that both images are kept preretinal and stimulus to accommodation prevented. To test the other eye, simply move the "fog" sphere being used as an occluder to the opposite side. When equality is reached, it can be double checked by the Jackson crossed cylinder.

The extent of the blur indicates roughly the amount of astigmatism. On the clock dial, on reducing sphere, when only one of the 12 lines is sharp while all the others are blurred, there is about 0.5D. of astigmatism. If three are sharp, there may be 1.0D. or more. If one line on the simple cross dial appears doubled, it indicates about 0.5D. minus cylinder should be placed in that axis.

In patients with astigmatism, it is important to test cylinder axis with the two eyes fusing. This is accomplished most simply by using a plus 1.25D. sph. instead of an occluder. Patients with oblique astigmatism are likely to have cyclophoria or rotary muscle spasm. If one eye is totally occluded, the other is free to rotate on the test chart as it pleases. If the cylinder axis is measured and glasses made according to this spurious monocular position, under binocular conditions the images will not fall on corresponding points. Fusional impulses will immediately rotate both eyes to satisfy corresponding points, and change the position of the eyes in respect to their spectacle cylinder axes, causing spherocylindrical refractive error. Cylinder axis, therefore, should be determined in the position of binocular action.

If the patient shows precision with the Jackson crossed cylinder as high as 0.12D, write the prescription with equal precision. If he cannot discriminate between 0.25D. and 0.5D, it is a waste of time to use 0.12D. cylinders. There are a few patients who will not be satisfied until the last eighth diopter of sphere and cylinder is in the trial frame.

Binocular tests at near

It has long been known that difference in astigmatic axis exists in the reading position. If one eye is totally occluded, the other eye always intorts when it looks down and in. Monocular incyclotorsion also occurs on simple adduction. In refraction, the error in cylinder axis as measured for near may be from 5 to 10 degrees, compared to that measured binocularly. Errors in small cylinders are much larger than those in large.*

When the astigmatic axes for distance are carefully measured binocularly, and compared to the axes determined binocularly for near, there is still a difference. Theoretically, one would expect incyclovergence, but excyclovergence is as frequently found. This difference in axis for distance and near is enough to be clinically important, and is worth study in problem patients. Usually, such patients are very sure in their answers on axis measurements. If the eyes are used chiefly for near, the axis prescribed should be measured at near, or two pairs of glasses ordered.

Binocular tests for axis of astigmatism at near are performed in convergence and deorsumvergence with the eye not under test "fogged" just enough to occlude the target letters or dial. The sphere is usually about 3.0D. Jackson crossed-cylinder tests for amount and axis of cylinder are used.

The use of plus sphere as an occluder to obtain binocular refraction tends to reduce the level of accommodation. The patient accepts more plus sphere because the unconscious reflex controlling the level of accommodation quickly discovers that relaxation sharpens vision while exertion causes blur. Other binocular techniques lack this effect on accommodation, but may be superior in high dominance of one eye.

* Miles, P. W.: Binocular refraction. Am. J. Ophth., 31:1460 (Nov.) 1948.

Cyclodamia and dominance

As a recheck of the refraction, place plus 1.5D. sph. before each eye in the trial frame containing the refractive prescription. The acuity should be about 6/60 and approximately equal in the two eyes. If the acuity is better than this, some relaxation in the accommodative level due to "fog" may exist. The sphere is gradually reduced binocularly, holding this relaxation by not permitting the eyes even for an instant to see without full plus correction. People vary in their ability to interpret blurred images, so this use of cyclodamia is subject to good judgment. On comparison of the two eyes, one eye may be physically better than the other, and no matter how much plus is added, the patient thinks he sees better with the dominant eye. If there is more than plus 0.5D. necessary to add to the better eye to equalize the acuity at the 6/60 level, the refraction should be repeated, or compared with that under cycloplegic.

The "fog" occluder for binocular refraction is not so helpful in patients with strong dominance. The recessive eye suppresses and shows poor precision in tests for astigmatism. It was found* that on stimulating the dominant eye to accommodate, the recessive eye followed strictly, but on stimulating the recessive eye, the dominant eye lagged behind. Most people have mild dominance, many have mixed, and some have very strong dominance. The latter is found in anisometropia, and in the less ametropic eye. The strongly dominant eye is accustomed to seeing better than the other, and in ocular movements is the first to fix on the object of attraction. If the new glasses permit the recessive eye to see better, there will be confusion when the recessive eye is forced to lead.

Dominance is tested clinically in three ways. The dominant eye should be selected in two times out of three.

1. The two index fingers are superimposed and brought up from the lap into the line of sight of a distant object.

2. A flat tin funnel device encloses both eyes at one end while the small end is aimed at a distant object.

3. A hand mirror with a small inkspot is held in both hands, and aligned so that the spot rests on the tip of the nose. In each case the "aiming" eye is dominant. Often the tests are unnecessary. Dominance is indicated by the anisometropia or amblyopia.

4. In the test for near point of convergence, the recessive eye turns out first unless it is comparatively myopic.

Never let glasses favor the recessive eye because it changes habits of long standing.

The binocular refraction with "fog" automatically adapts the accommodative level to conditions of exophoria or esophoria. A monocular refraction in a patient with exophoria will result in binocular blur for distance, while a patient with esophoria will accept more plus binocularly for distance.

Phoria studies

With the prescription in the trial frame following the noncycloplegic refraction, or at the post test in the absence of cycloplegic, the muscle studies are made. If the patient is greatly fatigued, the tests are not reliable. If there is great change from the glasses being worn, phoria tests with the new prescription are not reliable. Any change in sphere, or twice the change (its equivalent) in cylinder, will affect the accommodation-convergence ratio.

Phoria is conveniently and accurately measured by the Maddox rod and a single small light. It is recognized that there may be an innervation for fusion between the streak and the light, particularly if they are of the same color. It is not uncommon for the patient to localize the light accurately at 6 meters, but to believe the streak to be much nearer, say 2 meters. If the patient

* Miles, P. W.: Binocular refraction. Am. J. Ophth., 31:1460 (Nov.) 1948.

looks at the streak, he will converge according to the distance he believes it to be. If the phoria measured does not seem reasonable, repeat, or compare prism and parallax tests.

The Maddox rod test for near is done by use of a bare ophthalmoscope light. The phorometer is usually used for motility tests, but in many cases it saves transferring the lenses to use a single Risley prism mounted on a handle which can be held in front of the trial frame. The Stevens prism can be improvised by holding a 2-prism-diopter prism before the trial frame, rotating it until the light is seen on the Maddox-rod target. If it is rotated 45 degrees from vertical or horizontal, the error is 1 prism diopter, and so forth. The phorometer prisms are inaccurate due to distance from the eyes.

The correction of phoria by use of horizontal prisms is not very successful. Sometimes it is useful in presbyopes with convergence deficiency by placing prism in the segment. These patients may not do well with bifocals. In changing any pair of bifocals, it is wise to examine the old pair. Many persons are wearing bifocals with excessive decentration of the segment for near. If the lenses are plus, this relieves convergence deficiency. In such a case, beware of changing the decentration, even though it is excessive.

Vertical prisms should be prescribed when hyperphoria is unvarying, and the same with either eye fixing. Vertical phoria should be measured with the eyes in the reading position, looking through the refracting lenses 5 to 8 mm. below optical center. If there is much difference from that measured straight ahead, slab-off prism should be prescribed.

Accommodation for near

After the distance prescription is determined, the amplitude of accommodation should be taken to decide how much reserve a patient has in the reading position. A few letters about the size of J2 type may be used as a target while a meter stick is held at the bridge of the nose. The meter stick occludes one eye.

A child should report the letters beginning to blur at about 8 cm., or less, while a college student may blur from 8 to 12 cm.

In presbyopia, the segment strength should be such that one diopter residual accommodation is available for use. That is, whatever the fixation distance considered optimum for a particular patient, the near blur point should be one diopter nearer. For instance, if the optimum vision is set at 40 cm., one diopter nearer is 29 cm. If the optimum distance is 33 cm., the blur point at 1 diopter nearer should be 25 cm.

This "blur point" is most unreliable because of the variables present. Depth of focus varies with different pupil diameters. On approaching the eye, the image becomes larger and, therefore, less blurred. To avoid the latter variable, keep the target at the optimum distance and see if acuity is equal with a minus 1.0D. sph. before the prescription. Be sure that the middle distance, 1 to 2 meters, is not so blurred that the patient cannot do required work, such as read a sales slip on a counter, or see a wrinkle in the ironing. Take time to explain the limitations of bifocals to a patient.

Motility and fusion amplitudes

Most patients with asthenopia have defects in motility and fusion. Ductions, versions, and diplopia fields are highly important considerations. The subject is involved, and it is impossible to discuss in this short paper. In general, "push" plus in esophoria, and "push" minus in convergence deficit. However, where accommodation amplitude is weak, pushing plus is likely to give relief in spite of convergence deficit or even exophoria.

It has been said that if a patient is unable to fuse with a prism brought gradually to 18 prism diopters base in at near, nothing

less than surgery will give relief. Fusional amplitudes are decreased in asthenopia, and give some idea as to the prognosis. If the divergence-convergence ratio is abnormal, there must be phoria even though it does not show on tests. One may prescribe orthoptics on this basis.

Orthoptic exercises should be prescribed in symptomatic phoria or low fusional amplitudes. Simple exercises which can be performed at home should be prescribed if an orthoptist is not available. Exophoria or esophoria is benefited by making the patient stop suppressing. This is done by exercises which make the patient conscious of suppression, such as fixing on a finger while observing the diplopic images of a distant light. In convergence deficit, the patient may be taught to converge voluntarily without a near target, or may be given the ordinary target-to-nose exercise. Opticians will rent or sell patients a Keystone stereoscope trainer, or an Orthofuser.

Cycloplegic refraction

Any subjective test for astigmatism may be defective due to great depth of focus if the pupil is smaller than 2 mm. The patient is unable to see any difference in small cylinder changes. On the other hand, in some patients the aberration is so objectionable with the pupil larger than 5 mm. that tests are unreliable. Furthermore, it is difficult to be sure that cycloplegic acts equally on the two ciliary muscles.

Younger patients dilate about right in the dark for a few minutes without drops. In the elderly patient with pinpoint pupils, a drop of paredrine will usually open the pupil about the optimum for retinoscopy and refraction.

All children under 15 years of age should have homatropine refraction, and those with tropia or under school age should have 3-day atropinization. If a patient complains of asthenopia, and shows simple myopia, the myopia is highly questioned even if it persists under homatropine. Atropine is indicated. In ciliary spasm, the patient will say that the eyes feel better after the drops. Patients do not like atropinization of one eye at a time for refraction.

A full hour is allowed for homatropine, and more than one drop is administered. Atropine (0.5 percent) ointment is useful in children. Atropine acts more slowly than homatropine, and may even stimulate the ciliary muscle during the first hour.

Two college students complained of eyestrain after reading. Neither had worn glasses. One accepted: O.D., +2.25D. sph. ⊂ +0.25D. cyl. ax. 75°; O.S., +2.5D. sph. ⊂ +0.5D. cyl. ax. 100°. This one was not given cycloplegic, because even if latent hypermetropia had turned up, it would not have been prescribed at first. The other student was found emmetropic by subjective and retinoscopic tests. Homatropine revealed hypermetropia of plus 2.0D. in each eye. Since he did not have esophoria, only 0.75D. was prescribed.

There may be a difference in the axis of astigmatism with and without cycloplegic. The greatest weight is given findings with the pupil the size in everyday use.

Residual accommodation

After a cycloplegic refraction, test residual accommodation so that the completeness of cycloplegia may be estimated. This is conveniently done by placing in the trial frame the final prescription plus 3.0D., O.U. The J2 letters are used as a monocular test object, and brought up to the blur point. This near point in diopters, less the 3.0D., is the residual accommodation. (Diopters equals centimeters divided into 100.)

Theoretically, if cycloplegia is complete, the 3.0D. would put the optimum visual acuity at 33 cm., and the blur point would be only 2 to 3 cm. nearer, because of the poor depth of focus with a wide pupil. If the blur point is found 20 cm. from the eye, the residual accommodation would be 5.0D.

(20 cm.) minus 3.0D. (33. cm.) or 2.0D. Homatropine may leave more residual than this. The two eyes are compared. The test is not too reliable for reasons given before.

The "post" test

If the noncycloplegic refraction goes well, a "post" test is not necessary. However, in a problem case, it is wise to repeat tests for cylinder amount and axis again, as there is commonly a daily variation in spite of refined tests.

"Temps" or clip-ons

In the elderly patient who has worn a certain prescription for several years, it is wise to change it gradually, not all at once. Sometimes it is unknown whether a patient can wear the full hypermetropic or astigmatic prescription. To avoid expense of new glasses, one may try clip-ons over the old ones for two weeks to make certain the new prescription is comfortable.

Another way to accomplish the same economy is to have a stock of round lenses and cheap metal frames available to rent temporarily to patients. The Dartmouth Eye Institute had such a stock and found it exceedingly useful. Glasses were assembled and ready to wear in 10 minutes, and as soon as the patient had tried them, were restored to stock. Very few patients felt they were being experimented upon.

Every office will find clip-ons with various prism combinations useful in deciding whether or not prisms would be a helpful change.

Undercorrection

If it is decided to undercorrect astigmatism, the principle of spherical equivalents is used to arrive at a tentative prescription. This is placed in the trial frame, and fine adjustments in the sphere determined. The cylinder is decreased a given amount, half of which is added algebraically to the sphere.

If a prescription is: +1.0D. sph. ⌒ −6.0D. cyl. ax. 75°, and the cylinder is to be cut one third, the equivalent would be: 0.0D. sph. ⌒ −4.0D. cyl. ax. 75°. If it is a −1.0D. sph. ⌒ +6.0D. cyl. ax. 75°, and to be cut one fourth, the equivalent would be: −0.25D. sph. ⌒ +4.5D. cyl. ax. 75°.

The principle is also useful in estimating how much accommodation is stimulated by a given minus cylinder. A minus 4.0D. cylinder will stimulate an eye to accommodate 2 diopters. This principle is often forgotten in the use of "fogging" noncycloplegic dial refractions with minus cylinders. Minus cylinder is added without its equivalent in plus sphere, putting one image meridian postretinal.

Precision lenses and cornea to lens distance

Precision or corrected spectacle lenses are very fine, but often misused. Textbooks and trade brochures still describe the unscientific procedure of placing a corrected spectacle lens on one eye, and then matching the front curve and the edge thickness for cosmetic reasons on the other eye. If precision or corrected lenses are superior, why limit them to one eye? Suppose the dominant eye is fitted with the cosmetic curves?

When the ametropia is 5.0D. or more, it is important to measure the distance between the pole of the cornea and the rear surface of the principal lens in the trial frame. This distance should be supplied to the optician on the prescription. If the lens is at 18 mm., and the spectacles will be at 9 mm., there is an error of 0.25D. in a 5.0D. lens, and as high as 1.5D. in lenses for aphakia.

A formula that is not difficult to remember is: The difference of dioptric effectivity in a lens before the eye when placed at different distances is the original dioptric value squared times the distance moved in millimeters, divided by 1,000. It is easy to remember whether to add or subtract this change in value, because a plus lens becomes weaker as its approaches the eye, and a minus lens becomes stronger.

Monocular occlusion

There have been several cases reported of obscure binocular difficulties in which monocular occlusion succeeded when all else failed. However, many patients never tolerate occlusion. Some cases of diplopia, for instance those with aphakia, may be improved by monocular occlusion.

Anisometropia and aniseikonia

Anisometropia is a difficult problem, and may require aniseikonic correction. The asthenopia from unequal refraction of the two eyes may be from the following: (1) Anisophoria, with hyperphoria of the more hypermetropic eye in the reading position; (2) aniseikonia, if the ametropia happens to be lenticular or corneal, not axial; (3) fusion difficulties if the more hypermetropic eye happens to be unable to suppress, and develops amblyopia ex anopsia.

If a patient has merely the first condition, use a slab-off prism to relieve the hyperphoria in the reading position; or, in bifocals, adjust the optical centers of one or both segments. If it is the second condition, it can be diagnosed or inferred, but must be measured on special instruments and treated with special glasses. If the third condition is present, the patient may be encouraged to suppress by spectacles which fog the recessive eye in one way or another.

It is common procedure to give a patient measuring O.D., +1.0D. sph., O.S., +6.0D. sph., an undercorrection of the left eye. Usually in the absence of occlusion in childhood, the eye is amblyopic. A prescription of plus 1.0D. before each eye "cures" both anisophoria and aniseikonia. Uncorrected hypermetropia is less important in a suppressing eye. If such undercorrection is uncomfortable, and the full correction cannot be worn, aniseikonic tests are indicated.

Aniseikonia is measured only for a particular refractive prescription. Any refractive change, any change in curves or thicknesses, or cornea to lens distance change, will affect measurements for aniseikonia. There is no sense in measuring aniseikonia through trial frame lenses unless they are of precision quality, and all cornea to lens measurements are known.

A screening test can be performed through the new spectacles, which will positively indicate the amount of axis—90° aniseikonia present. Place two small equal lights, as from bare ophthalmoscope bulbs, about 6 feet in front of the patient, about 18 inches apart.

The patient's head should be directed and held straight ahead, and the lights placed exactly the same distance from the eyes, like headlights from an oncoming car.

Place a Maddox rod accurately before each spectacle lens on the patient, so that vertical lines are seen by both eyes. The lines should fuse so that only two frontal vertical lines are seen at the distance of the lights. If one target line is seen nearer to the eyes than the other, aniseikonia is present.

The amount and sensitivity can be measured by placing minus cylinders axis 90° before the eye on the side on which the target line is seen more distant. Such a lens makes the target line approach the eye on that side. A need for cylinder of 0.5D. or more indicates significant aniseikonic error.

Conclusion

A practical procedure for handling difficult refraction problems is submitted, incorporating cyclodamia and binocular technique. Various practical tests are discussed. The attempt is made to keep the writing on a student level.

640 South Kingshighway (10).

NOTES, CASES, INSTRUMENTS

LENS LOOP WITH SERRATIONS, LONGITUDINAL WIRES AND FLEXIBLE SHAFT*

CONRAD BERENS, M.D.
New York

A lens loop with serrations, two longitudinal wires, and flexible shaft (fig. 1, A and B) was devised because the conventional loop without serrations and cross wires affords too little overall contact and traction in the extraction of some lenses.

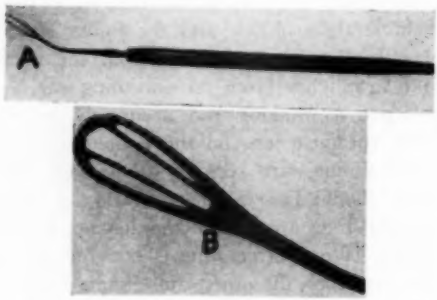

Fig. 1 (Berens). (A) Lens loop with serrations, longitudinal wires, and flexible shaft. (B) Enlarged view of loop.

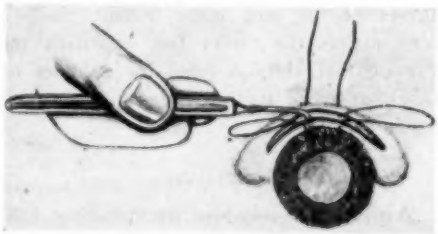

Fig. 2 (Berens). The shaft of the loop is adjusted at an angle of 120 degrees to the hexagonal handle of the instrument which is held lightly with the tips of the fingers. The posterior surface of the lens is engaged by the loop by gently rotating the handle in the fingers as the lens is extracted.

Loops without longitudinal wires give support and contact to the posterior surface of some lenses, especially the small lenses encountered in microphthalmic eyes.

The instrument is 14 cm. in length and has a hexagonal handle. The loop portion is 1-cm. long, 4-mm. wide, and has fine cross wires and serrations (fig. 1-B). The flexible shaft is 3 cm. in length.

ADVANTAGES

1. Serrations furnish a better traction surface than smooth wire in removing lenses.

2. Longitudinal wires improve support of lenses when soft or small as in microphthalmos and serve to depress the hyaloid membrane of the vitreous.

3. The flexible shaft permits the introduction of the tip almost at right angles to the shaft, facilitating the removal of the lens by rotating the shaft by finger movement rather than by hand or wrist movement.

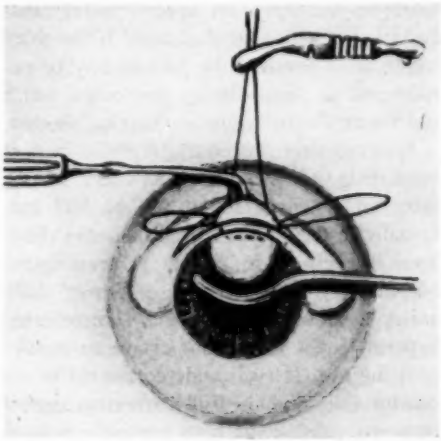

Fig. 3 (Berens). A preplaced double-armed corneoscleral suture is tightened as the lens is extracted by the loop and counterpressure from below exerted by a lens expressor.

*This work was aided by a grant from the Ophthalmological Foundation, Inc. The instrument is made by V. Mueller & Co., Chicago, Illinois.

Technique

The most satisfactory method of extracting the lens with this lens loop is to adjust the shaft at an angle of 120 degrees to the hexagonal handle of the instrument. The loop is held lightly with the tips of the fingers while it is introduced through the lips of the wound. The loop is then directed along the posterior surface of the lens which is engaged by slightly rotating the handle of the instrument in the fingers (fig. 2).

The lens is drawn out of the wound by the loop aided by counterpressure applied to its lower border through the cornea (fig. 3). Proper finger manipulation of the loop avoids undue gaping of the wound and facilitates extraction with minimum loss of vitreous. If the loop is kept in close apposition with the posterior surface of the lens, it is usually possible to extract the lens without loss of vitreous.

35 East 70th Street (21).

A NEW MODEL CONTACT LENS*

For observation of the eyeground and of the posterior part of the vitreous with the slitlamp

Sam Engel, M.D.
San Francisco, California

In examining the eyeground with the corneal microscope we have a twofold aim: (1) binocular observation under high magnification and (2) study of the tissue in the light of a narrow beam (slit) which, by contrast with the surrounding darkness, will allow keener observation and permit indirect observation of the overlying strata.

While stereoscopic ophthalmoscopy was possible before (Wessely, Thorner, Gullstrand), the magnification was less great and finer details of the posterior part of the vitreous body escaped detection in the diffuse light. Our interest in these observations, particularly of the posterior part of the vitreous, has greatly increased since the relation between detachment of the vitreous and detachment of the retina has been recognized.

It was known relatively early that the eyeground could be seen directly in an eye submerged under water (Méry,[1] 1704). La Hire,[2] in 1709, explained the phenomenon as due to the fact that water, having about the same refractive index as the cornea, neutralizes the refractive power of the cornea, and that rays which would normally leave the eye in a parallel direction will have a divergent course; that is, will appear as if they are coming from a point situated much forward (fig. 1).

Of early attempts to neutralize the refractive power of the eye for examining purposes only two need be mentioned: the "Orthoskop" of Czermak[3] (1851), a kind of glass eyecup that was filled with water and allowed observation through its anterior plane surface; and Stilling's[4] myopic lens of about 65 diopters (1878).

The modern microscopy of the posterior part of the living eye was particularly advanced by Koeppe,[5] who constructed a contact lens which neutralizes the refractive power of the eye and allows observation and likewise focal illumination of the eyeground.

A further requirement for examination of the eyeground is that the light beam and the axis of the observing system form an angle no larger than 15 degrees without having the arm of the slitlamp interfere with the objective of the corneal microscope. Koeppe accomplished this by attaching a silver mirror to the arm of the slitlamp. Use of the contact lens never became extensive because it was too heavy to stay in place. If the patient was in an upright position, it either slipped and disturbing air bubbles entered the lens cavity, or the lens fell out of the

* From the Department of Ophthalmology, Stanford University School of Medicine. Read before the fourth meeting of the Pan-Pacific Surgical Association, Honolulu, Hawaii, Septemebr 10, 1948.

eye. It frequently was necessary to apply pressure against the lower lid and to take precautions that the expensive glass did not break in falling down.

Examinations were usually performed with the patient lying down; consequently, both illumination and observation were less favorable. Therefore, Hruby[6] of the Lindner clinic (Vienna) designed a myopic lens of 54 diopters, with a convex observing plane of 5 diopters, which was placed before the eye in a trial frame. Examination with this lens, however, has the disadvantage that reflexes are often disturbing and that the myopic lens before the eye decreases the size of the obtained image.

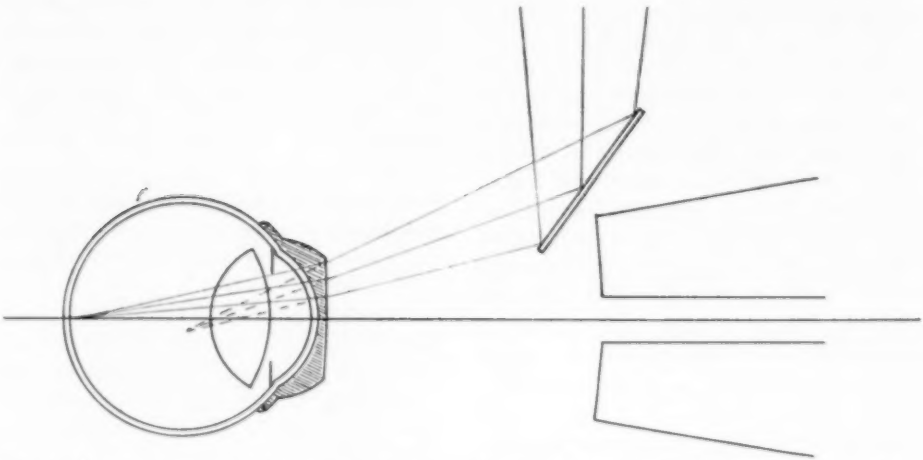

Fig. 1 (Engel). The course of convergent light rays after insertion of the contact lens is represented by the solid lines. The broken lines represent the course without the contact lens.

New model contact lens

Since we found the Troncoso[7] contact lens very satisfactory in our gonioscopic examinations, we felt that a similar lens with a plane or slightly convex surface should greatly facilitate examination of the eyeground. A contact lens was therefore constructed of plastic material (methylmethacrylate). Its insertion is very simple and easy and, as it is relatively light, there is no difficulty in examining patients in an upright position. It is even possible to have them walk to the slitlamp.

The lens consists of a corneal portion and a thin scleral rim of 3 mm. The inner corneal curvature is 7.5 mm. In some contact lenses, the scleral curvature is 12 mm.; in others, 12.5 mm.

The thin scleral rim allows the lids to come closer together and assists in holding the lens on the eye; it further diminishes the weight of the lens by approximately 25 percent in comparison to Thorpe's[8] lens in which—similar to the Koeppe lens—the convex outer band begins right at the scleral edge, while in the new model herein described, it starts 2 mm. inside the thin scleral rim (fig. 1).

Technique of examination

Sterilization of the contact lens should be done with a 1:1,000 aqueous solution of Zephiran. It should not be boiled or treated with heat, and dissolving solutions like alcohol or ether should never be used on it. The contact lens is treated with a wetting

solution to prevent fogging, rinsed most carefully under running cold water, held with a suction cup, and filled with normal saline solution.

After the pupil has been dilated as much as is feasible, the eye is anesthetized with 2 to 3 drops of a 0.5-percent solution of pontocaine, given at intervals of two minutes.

The patient, in a sitting position, bends his head forward and looks toward the floor. He pulls down on the lower lid of the eye with the index finger of the same hand, while the physician lifts the upper lid and inserts the contact lens as centrally as possible on the cornea, avoiding the formation of air bubbles.

After a slight pressure of about 20 seconds, the suction cup is released, and the patient is asked to move his head up and to put his chin on the chin rest. The slitlamp is moved far to the side of the eye under examination and the silver mirror is brought to a distance of 2 to 3 cm. from the eye (fig. 2). The light is directed toward the temporal part of the pupil by turning the mirror (about 45 degrees); the eyeground will appear red with faint lines of vessels.

The microscope is directed toward the part of the eyeground to be examined, and the light beam is focused on the retina, under observation through the microscope, by moving the arm slightly forward and backward. The slit itself should not be narrowed to more than half its size, as a relatively large amount of brightness is required.

Smaller movements of the light, vertically and horizontally, can be made with the help of the screws of the condensing lens. In order to observe the farther peripheral parts of the eyeground, one has to change the patient's fixation. These movements of the eye can be easily made without the formation of air bubbles.

Fig. 2 (Engel). Arrangement of corneal microscope and arm of slitlamp with silver mirror for the examination with the new contact lens.

When the examination is completed, the lens is taken from the eye by lifting slightly at the lower border with a strabismus hook. The magnification under which the eyeground is seen corresponds closely to the magnification of the microscope.

Summary

A new plastic contact lens for examination of the posterior part of the eye with slitlamp and corneal microscope is described. It allows observation of the patient in upright position.

The described technique is of particular value in examining detachment of the vitreous body, detachment of the retina, and changes of the disc and of the macula lutea.

350 Post Street (8).

I wish to thank Mr. A. H. Parsons for his assistance in designing and constructing the contact lens. The contact lens and the silver mirror are manufactured by Parsons Optical Laboratories, 518 Powell Street, San Francisco, California.

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AN ECONOMICAL SCREEN

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Battle Creek, Michigan

Wishing to call attention to an economical screen, this paper is presented, claiming no priority. I have used this screen for over 15 years and found it quite satisfactory.

The screen is simple in construction, light, well balanced, easily handled, and can be made in the office at an approximate cost of 75 cents per 100. Because of the low cost the screens may be placed in refraction booths, examining rooms, on the wards, office desk, treatment table and basket, or at any strategic point where it might be desirable to do a cover test.

A tongue depressor is used for the handle. The screen itself is cut from a Manila folder with two sides in duplicate, approximately 6 by 9 cm. in the shape illustrated.

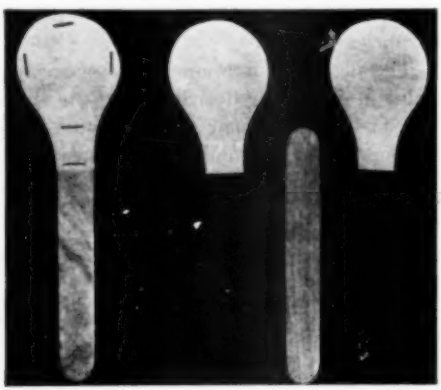

Fig. 1 (Albright). An economical screen.

They are then stapled to the end of the tongue depressor, one on either side, with an ordinary office stapler. Staples are placed near the periphery at 3, 6, 9 and 12-o'clock positions to hold the two sides together and increase its strength. The staple at the 6-o'clock position should include the upper end of the tongue depressor. A second staple should be placed through the tongue depressor and both sides of the paper portion approximately 3 cm. below the staple at the 6-o'clock position.

These screens can be readily constructed by the office nurse.

Percy Jones General Hospital.

* Chief EENT Section, Percy Jones General Hospital.

SUBCONJUNCTIVAL LUXATION OF THE LENS INTO A SCLERAL RUPTURE*

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Chicago, Illinois

Traumatic subconjunctival dislocation of the lens has been noted and recorded for many years and the older literature is replete with case descriptions but its luxation into a scleral rupture is relatively rare. I should like to add the following case.

CASE REPORT

History. On June 29, 1947, a Negress, a nurse, aged 29 years, requested emergency treatment at the Harlem Eye & Ear Hospital. Four hours previously she had been struck on her right eye in an altercation

* From the Department of Ophthalmology, Harlem Eye & Ear Hospital, New York City; Dr. C. B. Meding, executive surgeon.

with neighbors and now was unable to see clearly. The injury was due to a deliberate stab on the outer side of her right eye by the handle of a hair brush.

Ophthalmic findings. Extensive chemosis of the lids and conjunctiva were present in the right eye, and there was a large hematoma beneath the nasal half of the bulbar conjunctiva. A total hyphemia was present. Examination with the slitlamp using high illumination revealed no damage to the conjunctiva, sclera, or cornea but, through a blood-filled anterior chamber, the dim outline of the temporal edge of the lens could be distinguished. Light perception, although poor, was present.

Her left eye was clear and the fundus normal. With a correction of +2.5D. sph., her vision was only 20/200. Apparently she was amblyopic for this had always been "a weak eye."

Course. The patient was admitted to the hospital immediately and atropine (1 percent) was instilled in her right eye. In addition, she was given 20-million units of typhoid-paratyphoid vaccine intravenously and 50,000 units of penicillin intramuscularly. This was followed by 20,000 units of penicillin every four hours. She was sedated with pentobarbital and codeine as required.

The following day, a more thorough examination was possible for the anterior chamber had cleared. The lens was seen to be incarcerated in the intercalary portion of the sclera, and a large nasal coloboma of the iris was present. No break in the conjunctiva could be seen over the site of the hematoma.

She remained in bed for two days and, after that period, no further medication was given. During her two-week stay in the hospital, no signs of irritation developed, no hypertension appeared, and the hyphemia was partly absorbed. She was seen daily for another two weeks as an outpatient, and then twice weekly for several months.

As the anterior segment of the eye cleared, slitlamp examination showed the zonular fibers to be still attached to the temporal edge of the lens, but stretched enormously.

Since October, 1947, the vitreous hemorrhage has gradually cleared and the fundus is visible. Except for a fine thread of connective tissue stretching from the optic disc to the ciliary body, the eyegrounds are undamaged. The lens has gradually shrunken.

As a result of the enforced use the possible amblyopia that was present in her left eye has disappeared, and her vision is now 20/20 with a +2.5D. sph. ⊃ +1.0D. cyl. ax. 180°. She is able to perform her nursing duties. Her aphakic eye is correctible to 20/30 with a +11.5D. sph. ⊃ +2.0D. cyl. ax. 75°.

Discussion

Mechanism of injury. In indirect ruptures, the principal factor is the compression of the eyeball. In direct ruptures, there is added to the compression, a local indentation. This determines the site of the rupture, as the contents of the eye are suddenly subjected to an increased intraocular pressure. The globe responds as if an explosive force acted from within outward.

The fact that ruptures are so frequently situated above the cornea is attributed by some to deficient anatomical support; others stress the weak structure of the sclera at the site of Schlemm's canal. That most scleral ruptures start from a point situated above and inward is ascribed to the pressure of the trochlea.[1] In addition, the traumatic compression of the eyeball causes distention of the iris at its thinnest part, its insertion. Here, a total traumatic aniridia may occur or a traumatic coloboma of the iris may correspond to the location of the scleral rupture.

Iris injuries are generally accompanied by hemorrhage into the anterior chamber where the blood gravitates to the bottom and disappears later by resorption.

After concussion injuries resulting in rupture of the sclera, a laceration of the

ciliary body frequently occurs at its attachment and an entire separation of it from the sclera may take place. Hemorrhage into the vitreous body follows.

The aphakia produced results from the luxation of the lens into the vitreous or the subconjunctival space. The lens may be expelled. More rarely, subluxation is preceded by iridodialysis and laceration of the zonular fibers. The lens moves in front of the ciliary body and through the iris coloboma toward the place of rupture. Here, because of its size or the insufficient force, it may become incarcerated in the wound.

Prognosis. Added to the severity of such traumatic lesions is the danger of subsequent infection. Most eyes which have suffered a rupture, undergo destruction. It is the exception, in fact, for such an injury to recover with retention of serviceable vision.

Further complications include the onset of secondary glaucoma, detachment of the retina, and sympathetic ophthalmia.

SUMMARY

A case of incomplete subconjunctival dislocation of the lens is presented in which recovery with useful vision ensued. The mechanism of the injury is briefly described and the prognosis stated.

6 North Michigan Avenue (2).

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Fig. 1 (Eisenstodt). Preoperative photograph showing atrophic superfluous folds of skin hanging over the eyelid margins. Reduplication of the upper lip was evident only when the patient smiled.

BLEPHAROCHALASIS WITH DOUBLE UPPER LIP

LESTER W. EISENSTODT, M.D.
Newark, New Jersey

Blepharochalasis is a chronic disease of both upper eyelids in which repeated sudden attacks of severe edema occurs. The essential factors in the etiology and pathogenesis are unknown. It is probably a cutaneous manifestation of some constitutional disease. The condition was first described by Fuchs[1] who believed its etiology was on an angioneurotic basis.

Alvis[2] made an exhaustive study of the literature and defined blepharochalasis as a "chronic or recurring edema of the eyelids resulting in a laxity of the lid tissues with dilation of the vessels, thinning, wrinkling and discoloration of the skin, with finally a prolapse of orbital fat and the tear glands and a drooping of the lids." Alvis concluded that the only successful treatment was a surgical excision of the flabby skin. He also found that Ascher,[3,4] Wirth,[5] and Eigel[6] described the condition as associated with

a double upper lip. Gifford[7] believes "that some peculiar disorder of the vasomotor system is responsible."

It is the purpose of this paper to describe another case of blepharochalasis with a double upper lip.

Case report

History, R. G., a boy, aged 13 years, was referred for the cosmetic correction of his deformed eyelids. His history showed that, at the age of 7 years, he sustained a blow on the back of the head. Upon awakening the next morning, he found his upper eyelids severely swollen. After a period of time, the edema partially subsided. Since that time, several other sudden attacks have occurred periodically at 6 to 12-month intervals with diminishing resolution of the edematous skin. His mother stated that she has taken the patient to several clinics for diagnosis and treatment. No physiochemical, allergic nor endocrine disfunction was found and no specific therapy was advocated. Examination revealed a well-developed young man. The skin of both upper eyelids was very soft, loose, atrophic, reddish-purple in color, and superfluous, hanging in a fold over the lid margins (fig. 1). In order to see, the patient was forced to hold his head tilted backward. The redundant skin was easily picked up and pinched between the fingers. A very prominent double upper lip, due to a duplication of the sublabial mucous membrane, was noted. The superfluous mucous membrane was only evident when the patient smiled.

It was deemed advisable to excise the excess skin of the eyelids both for functional and cosmetic reasons. Local anesthesia was not employed since it would further balloon out the atrophic skin. Under sodium pentathol anesthesia, a large eliptical section of skin was excised from the superior palpebral sulcus to conceal the resulting scar. The extensive resulting defect was repaired by careful approximation of the

Fig. 2 (Eisenstodt). Postoperative photograph taken 13 months later after another attack of edema.

margins with multiple interrupted fine Dermalon sutures.

The superfluous mucous membrane causing the duplication of the upper lip was also excised and the wound closed directly with multiple interrupted sutures. A pressure dressing was applied to both eyelids and the upper lip for three days. The patient made an uneventful recovery and the cosmetic end result was quite satisfactory. The upper eyelids, however, retained their reddish pigmentation. After approximately four months, the abnormal pigmentation disappeared and the color of the eyelids blended with the surrounding structures. At this time, it was noted that the mucous membrane of the upper lip had again become redundant. It was subsequently excised under block anesthesia.

The patient's course was smooth and uneventful until exactly one year after the eye-

Fig. 3 (Eisenstodt). Taken 16 months after Figure 2, during an acute attack of edema. Note the sympathetic mild edema of the lower eyelids.

lid operation. He awakened one morning to discover another attack of severe edema of the eyelids with no other subjective reactions. Under Pyribenzamine therapy and ice compresses, the swelling rapidly regressed. The skin of the eyelids, however, did not undergo complete resolution and additional thinning and edema were noted (fig. 2). Examination also revealed the mucous membrane of the upper lip to be swollen. The following year two additional attacks occurred resulting in a reformation of the double-lip deformity and further atrophy of the skin of the eyelids (fig. 3). After an additional period of observation, further plastic surgery will be performed on the eyelid and lip.

Conclusions

1. A case of blepharochalasis with a double lip has been described.

2. The esthetic and functional end results of surgical correction of blepharochalasis were satisfactory but did not prevent further edematous attacks.

3. Excision of the superfluous mucous membrane causing the double lip deformity was twice performed with only a temporary satisfactory result.

4. It seems logical to conclude that, in this instance, a physiologic relationship exists between blepharochalasis and the double lip deformity.

31 Lincoln Park (2).

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HERPES ZOSTER OPHTHALMICUS

A case with manifold complications

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Brooklyn, New York

Herpes zoster ophthalmicus is comparatively uncommon. The occurrence of ophthalmic zoster with manifold ocular complications in a single instance is rare.

Case report

History. Mr. A. S. G., aged 45 years, who had been in excellent health, was awakened from sleep during the early morning hours of July 1, 1946, with a sharp pain deep in,

and around, the right eye. Within a few minutes he became nauseated and vomited a number of times. Four days prior to this episode he had had a mild upper respiratory infection.

An ocular examination later that morning did not reveal any organic reason for his distressing symptoms, although ocular movements did seem to aggravate the existing pain. A nose and throat consultation did not reveal any significant abnormalities. In spite of analgesics, the ocular pain continued, and so did the vomiting. On the third day, a neurologic consultation was requested and the patient was admitted to the hospital with the diagnosis of a possible supraorbital neuritis. In order to relieve the pain, an alcohol-novocaine injection about the supraorbital nerve was performed that afternoon.

The next day, various-sized, intradermal, amber-colored vesicles appeared over the right frontal and temporal areas. A few of these vesicles were situated on the right side of the nose. The upper lid was swollen. The right bulbar conjunctiva was intensely congested and extremely edematous. It protruded through the palpebral fissure and overlapped the cornea making it appear to be about one-half its normal size. The right pupil was semidilated and reacted sluggishly to light. The ocular movements did not appear to be restricted. The excruciating pain had almost subsided.

The characteristic distribution of the vesicles and the course of events which followed confirmed the diagnosis of herpes zoster ophthalmicus.

Laboratory reports of the blood Wassermann, blood counts, urine, and X-ray studies of the skull and sinuses were all normal.

Course. More vesicles appeared over the right frontal area the third day. The right upper lid and the bulbar conjunctiva remained edematous. The right pupil remained semidilated. The superior margin of the right optic disc appeared somewhat indistinct.

Four days after the appearance of the vesicles, diplopia was noted by the patient. The right eye was definitely proptosed. The patient was unable to rotate the eye in any direction. The pupil was now a vertical ellipse. It did not react to light. The lid and conjunctival edema appeared to be decreasing.

The patient was discharged from the hospital on the 8th day after the eruption of the vesicles. The ophthalmoplegia and proptosis of the right eye remained unchanged. Due to the conjunctival edema, exophthalmometer readings were not possible.

On the 12th day after the eruption of the vesicles, the patient complained of pain in the eye. The upper temporal half of the cornea revealed confluent and discrete subepithelial opacities with fine blood vessels penetrating the substance of the cornea in that area. Precipitates were present on the posterior surface of the cornea. The media was cloudy and the fundus details were indistinct.

On the 20th day after the eruption of the vesicles, incomplete lateral, medial, and downward movements of the right eye became apparent. The lid and conjunctival edema, as well as the proptosis, were perceptibly diminished. The corneal opacities remained. The precipitates on the posterior surface of the cornea had disappeared. The fundus details were much clearer. At this juncture the patient developed an extreme degree of photophobia. He had to remain in a darkened room, wearing dark glasses, in order to be comfortable. This lasted for nearly three weeks.

Outcome. Within three months after the onset of the ophthalmic herpes, the lid and conjunctival edema subsided. The proptosis was gone, but a moderate degree of ptosis of the right upper lid remained. The ocular movements of the right eye, laterally, medially, and inferiorly, were normal, but the action superiorly remained impaired.

One and one-half years later, there remained a moderate degree of ptosis of the right upper lid. The right superior rectus muscle remained impaired. The subepithelial

corneal opacities, with a brushlike fascicle of vessels from the superior temporal limbus, remained. Sensitivity of the right cornea was impaired. The pupil remained semidilated and fixed. There was no reaction to light. The fundus appeared normal. The vision of the right eye which had been corrected to 20/20 before the onset of the herpes ophthalmicus could now be corrected to 20/40-2.

During the entire period the patient has had intermittent neuralgic pains, feelings of tightness, and tingling sensations over the right frontal region and right side of the scalp.

Discussion

Cases of herpes zoster ophthalmicus have been divided into two groups—essential and symptomatic. Infection is responsible for the symptom manifestations in the essential group. This often occurs in epidemic form. Clinical and bacteriologic evidence has been accumulated to show that its cause is identical or very closely allied with that of chicken pox.[1]

Although the clinical manifestations of the symptomatic group resemble epidemic zoster, the cause is different. Here the eruption is not the result of the activity of a virus, but is due to the secondary involvement of the sensory nerve or posterior root ganglion in the wake of another lesion, inflammatory, traumatic, or neoplastic.[2]

The trigeminal nerve resembles a spinal nerve, being made up of a compressed group of afferent, posterior roots. Its ganglion, the gasserian, is a fusion of posterior root ganglions of all the posterior sensory roots, corresponding to all motor nerves from the brain stem. The nerve enters the pons midway between its lower and its upper border and sends an ascending root upward to the brain stem and a descending root to the tissues as far down as the second cervical level.

There are three divisions of the fifth nerve—the ophthalmic, the maxillary, and the mandibular nerves. The ophthalmic nerve is purely sensory. It arises from the anterior margin of the gasserian ganglion, passes upward and forward in the external wall of the cavernous sinus, and on reaching the sphenoidal fissure, breaks up into its terminal branches. These are: (a) the recurrent, (b) the communicating, (c) the lacrimal, (d) the frontal, and (e) the nasal.

The recurrent branch is distributed between the layers of the tentorium cerebelli. The communicating branches join the trunks of the third, fourth, and sixth nerves, to whose muscles they supply sensory fibers.

Within the orbit, the lacrimal branch communicates with the temporal branch of the temporomalar nerve and, on the face, with the temporal branch of the facial nerve. The latter is one of the numerous sensory-motor communications between the terminal fibers of the fifth nerve and the seventh.

The frontal branch, which divides into the supratrochlear and supraorbital nerves, communicates with branches of the facial nerve.

The nasal branch, after being divided into (a) the ganglionic filament which enters the upper portion of the ciliary ganglion and helps to form the sensory or long ciliary nerve; (b) the long ciliary branches which join the short ciliary nerve; (c) the infratrochlear, (d) the septal, (e) the external nasal, and (f) the anterior nasal filaments, is distributed to the areas named.

The ophthalmic nerve with the ciliary ganglion supplies sensation to the upper lid, conjunctiva, eyeball, the lacrimal gland, forehead, the anterior part of the scalp, frontal sinus, the root and anterior portion of the nose, and the caruncle; and a branch from the ciliary ganglion enters the optic nerve with the central artery of the retina.

The ciliary ganglion lies in the orbital fat. It is made up of a filament from the nasal branch of the ophthalmic nerve, fibers from the oculomotor nerve, and a branch from the cavernous plexus of the sympathetic

chain. Its branches are the short ciliary nerves, which accompany the long ciliary nerves and pierce the sclera near the entrance of the optic nerve. The short ciliary nerves are distributed to the cornea, the iris, and the ciliary body.

In a comprehensive review, Edgerton[3] recorded all the salient factors of herpes zoster ophthalmicus and its complications. The disease may or may not be of long duration. It occurs with greatest frequency and with most severity in the latter half of life. No race, age, or sex is immune from this disease. Like herpes in other parts of the body, herpes ophthalmicus is usually unilateral and nonrelapsing.

The clinical picture of herpes zoster ophthalmicus is quite characteristic. Diagnosis is not difficult except in the stage before the eruption appears. General symptoms of malaise, headache, nausea, chills, fever, and anorexia may precede the eruption by several days. Subjective symptoms, especially excruciating pains of neuralgic type along the entire ophthalmic branch of the trigeminal nerve, at times radiating to other branches as far as the occiput, may precede the eruption by hours or several days.

Approximately 50 to 60 percent of the cases of herpes ophthalmicus have ocular complications. Thirty-three percent of these cases have corneal involvement. Seven to 24 percent of the reported cases have ocular muscle paralysis. Proptosis is rare and has been recorded only a few times.

Pathologically, Head and Campbell[4] reported the autopsy findings in 23 cases of herpes zoster examined at all stages of the disease. Ganglionic hemorrhages were found in recent cases, sclerosis in old cases, and destruction of the cells in proportion to the severity of the infection.

Muscular paralysis has been ascribed to thrombophlebitis.[5] Proptosis has been ascribed to either excitation of the sympathetic fibers of the superior cervical ganglion, or to muscle atony when it accompanies oculomotor paralysis.

Donahue[6] theorizes that, "from an anatomic and pathologic point of view it would seem that a 'spilling over' of the infectious processes from sensory to motor branches would be a more logical explanation in as much as the first branch of the fifth nerve sends out sensory ramifications to all the motor nerves of the eye before it enters the orbit."

Comment

The sequence of complications that occurred in the case herein presented was as follows: (1) Acute herpes zoster ophthalmicus, (2) proptosis, (3) complete external and internal ophthalmoplegia, (4) nonulcerative keratitis, (5) acute iridocyclitis, (6) extreme photophobia, (7) ptosis, (8) paresis of the superior rectus muscle, and (9) paralytic mydriasis.

With the possible exception of the optic nerve, almost every part of the eyeball was involved. This clearly demonstrates how extensively the globe and its adnexa may be involved and damaged by this disease.

Although the length of time varies greatly, paralysis of the ocular muscles in most cases clear up completely. Ptosis, in some cases, may remain indefinitely. This patient may, or may not, recover completely; but after one and one-half years the ptosis, the paresis of the superior rectus muscle, the corneal opacities, and the paralytic mydriasis remain unchanged.

Summary

Herpes zoster ophthalmicus is comparatively uncommon. Its occurrence with manifold complications in one individual is rare. In the case presented, the sequence of events occurred in this order. Excruciating pain in and around the right eye, with nausea and vomiting for four days prior to the eruption of the vesicles. These were typically distributed over the right frontal, temporal, and nasal regions.

Proptosis, with complete external and internal ophthalmoplegia, appeared four days after the eruption. Eight days later there followed a nonulcerative keratitis with acute iridocyclitis and extreme photophobia. One and one-half years later, the ptosis, the corneal opacities, the paresis of the superior rectus muscle, and the paralytic mydriasis of the right eye remain.

881 Washington Avenue.

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Ophthalmic Miniature

"If thou examinest a man having a smash of his skull, under the skin of his head, while there is nothing at all upon it, thou shouldst palpate his wound. Shouldst thou find that there is a swelling protruding on the outside of that smash which is in his skull, while his eye is askew because of it, on the side of him having that injury that is in his skull; (and) he walks shuffling with his sole, on the side of him having that injury which is in his skull, thou shouldst account him one whom something entering from outside has smitten, as one who does not release the head of his shoulder-fork, and one who does not fall with his nails in the middle of his palm; while he discharges blood from both his nostrils, (and) from both his ears, (and) he suffers with stiffness in his neck. An ailment not to be treated."

Breasted, *The Edwin Smith Surgical Papyrus* (3000 to 2500 B.C.).

SOCIETY PROCEEDINGS

Edited by DONALD J. LYLE, M.D.

NEW ENGLAND OPHTHALMOLOGICAL SOCIETY

January 21, 1948

DR. EDWIN B. DUNPHY, *presiding*

TETRAETHYL PYROPHOSPHATE

DR. W. MORTON GRANT, of Boston, described this new anticholinesterase miotic. He said that tetraethyl pyrophosphate (T.E.P.) is a new and highly active cholinesterase inhibitor which has previously been used as an insecticide, but during the past months has been under investigation at the Howe Laboratory and Massachusetts Eye and Ear Infirmary as a new agent for treatment of glaucoma.

In normal eyes, T.E.P. appeared to compare favorably with eserine and D.F.P. in miotic activity, and to be innocuous to the cornea.

In the treatment of glaucoma in 15 patients, it was observed that when pilocarpine had some effect in lowering the tension, T.E.P. was considerably more effective, although administered in much smaller amount. When used excessively, T.F.P. produced unpleasant symptoms like those produced by eserine and D.F.P. Also, in two patients an increase in tension instead of a decrease followed application of T.E.P. A more quantitative comparison of T.E.P. with other cholinesterase inhibiting miotics is being carried on.

Discussion. Dr. David Cogan opened the discussion, stating that eserine, D.F.P., and T.E.P. have the same general mode of action. He had tried D.F.P., in 1943, but concluded that it had no advantage over eserine, and had thought T.E.P. was apparently just another of those miotics, at least superficially. His attention has been directed by Dr. Grant to other factors; (1) D.F.P. appears to lose its activity more rapidly than T.E.P.; (2) expense of production may be different; (3) that there is a disparity between D.F.P. and T.E.P. in their miotic effectiveness in guinea pigs as compared with man, T.E.P. being much more effective than D.F.P. in the guinea pig, which Dr. Grant thinks is due to species differences in the reactivity of the cholinesterases. Dr. Cogan concluded that there may be circumstances other than simple mode of action of the drugs which determine the superiority of one drug over another.

Dr. Edwin Dunphy asked Dr. Grant if T.E.P. caused dilatation of vessels in the iris, or any conjunctival congestion. Dr. Grant replied that one or two normal human volunteers showed slight conjunctival injection when minimal concentrations were determined, and some redness of the eye was noted in 2 or 3 patients, with one having marked redness. In regard to cells or flare in the anterior chamber, he had seen neither when the eyes were examined either one hour or 48 or more hours after the first dose. This does not entirely preclude the possibility, since Dr. Dunphy has said that with D.F.P. the most marked cellular reaction occurs in the first 24 hours, and he had not examined his patients at that stage.

CONCERNING APHAKIA

DR. ALFRED COWAN, of Philadelphia gave the principal paper of the evening. He briefly reviewed the changes in the optical characteristics of an eye that has had a cataract extraction. The retinal image is one-third larger than before surgery, and the aphakic eye has no accommodative ability. The change in the principal and nodal points causes a slight change in the visual axis. With removal of the lens the eye becomes

hundreds of times more sensitive to violet and ultraviolet light. In addition, nearly every aphakic eye must be considered a mutilated eye. The persons who have had cataracts removed have an entirely different sight when corrected, and it is surprising that they are not more confused and even disappointed.

The shape and location of the correcting lens is important as it may differ from the trial lens. One must be certain that the optical axis of the lens coincides with the visual axis, which is frequently not the center of the pupil, especially when the pupil has been altered. In binocular aphakia, failure to center the lens properly or marked differences in the strength or nature of the correcting lenses produce various effects. Tilting of the correcting lens may cause an undesired cylindrical effect.

In order to determine the proper correcting lens, Dr. Cowan suggested arranging the plano trial lenses so that the finished spectacle lens can be more closely duplicated in the trial lens combination.

Fused and one-piece bifocals can be obtained, but the segment should be so cut that the base is down to neutralize somewhat the strong prism base up present in the lower portion of the distance lens. Therefore, flat-top segments are basically wrong in any bifocal with convex distance lens. The practicality of cement bifocals should not be overlooked.

Despite reports to the contrary, Dr. Cowan feels that correction of monocular aphakia (one eye normal with good vision) is impractical not only because of the diplopia due to the aniseikonic and prismatic effect of the difference between the glasses, but also due to one eye having more or less dynamic accommodation, the other eye no accommodation. Even if the retinal images are made more nearly equal by contact lens or minifying lens, and so forth, it is possible to superimpose them perfectly only for one distance at a time. Therefore, the binocular vision is not good and may be a cause of discomfort when so obtained. However, if the patient is comfortable with such limited binocular vision, there is no reason why he should not be given it.

In monocular aphakia and immature cataract in the other eye, the eye chosen for correction will usually be the one with the better visual acuity, although sometimes the patient will prefer the eye with the poorer but more natural vision. After the combined type of operation, the type and excessive amount of light may be very annoying. Dark glasses to be used when the occasion warrants may be given, but should not be for constant permanent use.

Discussion. Dr. Frederick Verhoeff opened the discussion on Dr. Cowan's paper. He said that he prescribed the correcting lenses in the aphakic eye 6 to 7 weeks after the operation, specifying flat lenses. By experience he has learned to order the lens 0.5D. stronger than that found by the trial set. He has found that people get used to a cataract lens surprisingly quickly. When the patient returns with the glasses, he will try improving the vision by changing the distance of the glasses from the eyes and by tilting the glasses. In binocular aphakia cases, he will have the patient cover one eye and move the head until he finds the best vision, and then change the cover to that eye. If the patient gets good vision in the other eye with the head in the same position as for the first eye, Dr. Verhoeff is satisfied. He agreed with Dr. Cowan's reasons in regard to the inadvisability of trying to prescribe lenses to give binocular vision when one eye is aphakic.

Dr. Albert Sloane said that house officers comment that it is easier to do a cataract operation then to refract a cataract case. He assumes that the first pair of glasses is usually temporary, and when the patient returns six or more months later he refracts the patient over their own glasses, since the position of their glasses is probably permanently

set, thus coming to a finer end point.

In the general discussion Dr. Edward Cramton asked about the use of trifocals in bilateral aphakia, and Dr. H. B. C. Riemer about using trifocals. Dr. Edwin Dunphy noted the divergence of opinion that exists about operating on the second eye when a good result has been obtained in the first. A surgeon in Dr. Dunphy's practice was unhappy with monocular 20/20 vision, and was much more satisfied when his other eye had been operated on. On the other hand, Dr. John Wheeler did very satisfactorily with only one eye.

Dr. Black was surprised to learn that the recommended addition for near was about 2.75D. In England the common practice was to give a 4.0D. addition. He said that these people like it and seem to appreciate such a near point. Dr. Verhoeff commented that with good visual acuity one does not need a strong addition, that he gives an addition of 2.5D., increasing it as necessary with lowered visual acuity. Dr. Judd Beach thought that most patients with fairly good vision preferred less strong additions, that is, about 2.5D. or 2.75D., and then could slide their glasses down their noses for additional magnification.

Dr. Cowan in closing the discussion said that Dr. Verhoeff arrived at the same correcting glass by his method, whereas Dr. Cowan's method was more direct and accurate. He thought Dr. Sloane's method was excellent, but it meant the purchase of two pairs of glasses which some patients could ill afford.

Furthermore, Dr. Cowan does not believe that one can get a more or less permanent correction for the refractive errors in less than 2 or 3 months after the operation, that most surgeons do not realize the terrible insult that an eye sustains when it is operated on for cataract which he reported in detail some years ago.

Dr. Cowan said that comparatively few bilateral aphakias have binocular vision, that most eventually suppress one eye. He thinks trifocals are very good, but you have to be careful for whom you prescribe them. All bifocal segments must be placed on the spherical surface of a lens. He also felt that a 4.0D. addition for near vision brought the focus too close; that while it gives a larger image, the field is more restricted and, in binocular cases it often causes discomfort to converge that close. He prescribes a 2.5D. addition in those cases with normal visual acuity. In regard to operating on the second eye in an older person when a good result has been obtained in the first eye, he thought it was just looking for trouble.

Mahlon T. Easton,
Reporter.

NEW YORK SOCIETY FOR CLINICAL OPHTHALMOLOGY

January 5, 1948

DR. DANIEL KRAVITZ, *president*

THE NATURE OF HEREDITY

DR. THEODOSIUS DOBZHANSKY discussed this subject during the instruction period.

CONGENITAL ANOMALIES IN THREE SIBLINGS

DR. BERNARD KRONENBERG presented a syndrome in three siblings which consisted of a basic microphthalmia and a number of congenital lesions. The family presented consisted of eight children with normal parents, who were first cousins. Five of the children were normal, and three of these five have a total of six children, all of whom are normal. The affected children are as follows:

Case 1. Carlos N., aged 19 years, shows microphthalmia, coloboma of the iris, marked nystagmus, and fixation in convergence of both eyes. At the age of 12 days, he developed an external ocular infection which led to the formation of a corneal opacity of the right eye involving almost the entire

cornea and leaving only a lunar-shaped sector up and out.

Case 2. Carmen N., aged 16 years, has microphthalmia, with ectropion uveae of both eyes, and ectasia of the pupils. She also shows coloboma of the optic nerve and macular area, and marked nystagmus, and the eyes are fixed in convergence. The right eye also shows remnants of a hyaloid artery and a posterior polar lens opacity. The left eye in addition to the anomalies mentioned has a subluxation of the lens with coronal lens opacities and a persistent pupillary membrane.

Case 3. Celia N., aged 15 years, has microphthalmia, but not as marked as that of her brother and sister. She also shows a coloboma of the optic nerve and iris, and marked nystagmus, and her eyes are fixed in convergence, although she is the least affected of the three.

Dr. Kronenberg said that microphthalmia has been reported in the literature for the last 170 years. Its association with the anomalies herein described has also been reported frequently since the earliest account by Block in 1774. It has been reported as a dominant as well as a recessive form, and by one author, W. H. Ash (1922), was reported to be sex-linked. Van Duyse differentiated three types of microphthalmia: the pure form, microphthalmia associated with coloboma, and microphthalmia associated with other congenital anomalies without coloboma.

The basic cause of these anomalies has been the center of controversy; one group of authors believing it to be an ectodermal defect and another group a mesodermal defect. The ectodermal theory is that the delay in the closure of the fetal cleft is due to a defect in the neuroectoderm. This delay leads to the formation of colobomas and also permits the fetal retina to wander outside the eye. The mesodermal theory is based on the fact that there is a persistence of capsulopupillary vessels in cases of coloboma irides. This does not allow the ectodermal tissues to develop normally and thus causes colobomas.

Dr. Kronenberg stated that in the cases presented, he believed that one defective gene was transmitted by each parent, for a basic anomaly. He said it was hard to believe that there could be a defective gene for each of the anomalies present. The complete normality of the unaffected children also speaks against the possibility of more than one defective gene. Dr. Kronenberg said that he assumed that the basic anomaly was a defect in the ectodermal anlage causing a delay in the closure of the fetal cleft which, in turn, caused the microphthalmia. The other defects, therefore, must all be secondary to the basic anomaly and were determined during pregnancy by incidental factors. The nystagmus is explained on the basis of the presence of colobomas in the macular area, and the high myopia, which was present in all three cases, can only be explained on the basis of a spherical change in the lens.

Heredity in ophthalmology

Dr. Harold F. Falls first presented a discussion of the basic principles of heredity. The essentials were reduced to their simplest forms grounding them on chromosome behavior. The importance of reduction division in oogenesis and spermatogenesis was stressed. The observation that most pathologic conditions of the eye may present similar phenotypes (clinical or physical appearance) but different genotyes (germplasm) was developed as the theme of the paper.

Dr. Falls then discussed the three most commonly encountered types of human inheritance—dominant, recessive, and sex-linked inheritance. He then reviewed the better known and most interesting anomalies.

Cataract may be congenital, juvenile, or adult in time of appearance. Dominant, recessive and sex-linked patterns of inherit-

ance have been reported. Senile and presenile cataract is commonly strongly heredity.

Pedigrees of hydrophthalmos, juvenile, adult, and senile primary glaucoma have been reported from time to time. The prognosis for retention of useful visual acuity is poorest in the order named. Hydrophthalmos has been most frequently seen in sex-linked and simple recessive forms. Juvenile and adult types of glaucoma have been demonstrated to be dominant transmission. The interested and alert physician will stress the hereditary aspect of this disease to his patients and their relatives. The instigation of early therapy is requisite to preservation of vision.

Strabismus, external ophthalmoplegia, and anomalies of the external ocular musculature may and do most frequently exhibit hereditary transmission. Information and data important and pertinent to the diagnosis, prognosis, and treatment of herterotropia may be obtained from careful investigation of the affected members, antecedents, and siblings.

Various types of inheritance patterns have been reported associated with aniridia, microcornea, megalocornea, cornea plana, coloboma of the iris, ectopia pupillae, ectopia lentis, and defects of the mesodermal leaf of the iris.

As a result of the modern trend to establish the etiology of many pathologic phenomenon previously classified as disease, recent profound interest has evolved in ocular abiotrophy. An abiotrophic disease is usually hereditary in character, developing in fully mature and normal tissue and appearing in different families at different periods of life. Various forms may be manifested within a family but there is always a strong resemblance as to onset and course. Constitutional abiotrophies which affect most of the ocular tissues and functions are now recognized. Retinitis pigmentosa is an abiotrophic disease as is gyrate atrophy, choroideremia, and retinitis albescens punctata. Many varieties of macular degeneration are known and recognized as an abiotrophic phenomena. The choroidal abiotrophies present generalized central or peripapillary choroid arteriosclerosis and degeneration with secondary retinal dyscrasia.

Hereditary osseous and mesodermal dystrophies are well known. Their ocular associations have attracted voluminous writings of recent date. Arachnodactylia, an extensive anomaly of the osseous structures and characterized by outstanding lengths of the body, extremities and digits, has been very well studied. Over 50 percent of the affected individuals have associated ocular anomalies.

Morquio's disease, an osseous dystrophy, can involve the entire skeleton and may have associated optic atrophy. The triad of fragilitas ossium, otosclerosis, and blue sclerotics is a well-established syndrome. The Lawrence-Moon-Biedl syndrome incorporates pigmentary degeneration of the retina, polydactylism, mental deficiency, hypogenitalism, and obesity.

Cranial deformities such as oxycephaly and the related conditions, acrocephalosyndactylia, Couzon's disease, hypertelorism, may have such associated pathologic conditions as strabismus, exophthalmos, optic atrophy, and keratitis.

The term "phakomatoses" has been suggested by van der Hoeve for the group of syndromes which include Bourneville's, von Recklinghausen's, von Hipple-Lindau's and Sturge-Weber's diseases. These syndromes have many features in common but yet are specific clinical entities. All exhibit congenital origin, wide constitutional and ocular features, and are heredofamilial. Small nevi or birth marks of the skin and mucous membranes, localized cystic tumor masses of widespread distribution and associated congenital anomalies are common manifestations. Lesions of the retina and optic nerve are common in Bourneville's disease. Neuro-

fibromatosis exhibits cystic retinal and optic-nerve changes as well as tumorlike changes in the lids and orbit. Angiomatosis retinae may exhibit angioma, cysts, and degeneration of the retina. Choroidal angiomatous lesions and glaucoma may be present in Sturge-Weber's disease.

Amaurotic idiocy may assume many forms of expression which are pathologic entities but have many points of similarity that suggest a basic underlying pattern of pathology.

Tay-Sachs's disease, juvenile amaurotic idiocy, Batten-Mayou disease, and Nieman-Pick's disease have much in common. Gargoylism and extrapyramidal paralysis with retinitis pigmentosa exhibit a smilar basic pathologic condition of the central nervous system.

Bernard Kronenberg,
Recording Secretary.

LOS ANGELES OPHTHALMOLOGICAL SOCIETY

November 18, 1947

DR. ORWYN ELLIS, *chairman*

SYMPOSIUM ON DIABETES MELLITUS

A. Internal Medicine. DR. KENDRICK SMITH (by invitation) defined the problems of the internist and ophthalmologist in the management of the diabetic patient. Ocular complications are experienced by all diabetic patients except the very young.

A transitory weakness in accommodation occurs because of a change in the glycogen deposit in the ciliary muscle and an osmotic shift in the lens. This alteration may be rapid and take place in a few days, or slow and escape detection until lens changes have occurred. Central retinal hemorrhages and hypoglycemia may produce blurring of vision.

Five percent of all diabetics have senile cataracts. The surgical risk is somewhat greater in these cases. The prognosis may be in doubt because of retinitis which becomes evident after the lens is removed. Postoperative hemorrhage is frequent but this complication can be lessened by allowing a moderately increased blood sugar level, since the incidence of hemorrhage is higher in hypoglycemia. It is therefore better to have a continuous glycosuria of mild degree, but the patient must be in nitrogen balance without ketone bodies. Hypoglycemia may itself cause cataract in a small percent of cases.

Toxic amblyopia and neuritis due to tobacco and alcohol occur more frequently in the diabetic patient possibly due to decreased blood supply.

Formerly lipemia retinalis was a poor prognostic sign. It is the result of an acute metabolic disturbance in young, uncontrolled diabetics, but now no higher percentage of mortality is found in these cases.

Diabetic retinitis has been increasing in frequency with each survey. It was reported in 8 percent of the cases in 1921, in 17 percent in 1934, and in 30 percent in 1946. A recent survey by Koff showed 50 percent to be affected. Internists should recognize the condition early. There is no good treatment for diabetic retinitis with venous disease and its proliferative retinitis. Rutin has been widely used because of the change in capillary fragility which is more evident in diabetic patients, but its value is to be questioned. Dr. Smith discouraged the use of rutin, hesperidin, and vitamin C. Some investigators have advocated the use of plasma proteins for help in the resorption of hemorrhages and exudates. Anticoagulants may have some effect but are dangerous because of possible hemorrhage.

Kimmelsteil-Wilson syndrome of chronic nephritis and diabetes may occur and accounts for 20 percent of the cases. Treatment of the glomerulonephritis and edema

by acacia to increase the outflow of urine has been of help.

B. Ophthalmoscopy. Dr. Stephen Popovich stressed the characteristic and pathognomonic nature of the diabetic retinopathy. He emphasized the fact that neither the age of the patient nor the severity of the disease is of importance in the development of the retinopathy but merely the duration. Slides were used to describe the various lesions.

C. Pathology. Dr. Hugh Edmondson (by invitation) discussed the relationship of the pancreas and diabetes. Hyaline degeneration of the islets occurs in 98 percent of the cases, but hyperplasia may be found. In the rest of the body the disease is in the vascular system with presenile aging of the vessels and atherosclerosis, accompanied by extensive cholesterol deposits. Patients controlled on diet alone had somewhat earlier onset of retinopathy than those on insulin, but the duration of the disease was the only consistent factor in the series presented. The cement substance of the body is important in the production of diabetic retinitis. Crystalloids, fluids, and proteins do not pass through the cytoplasm of the endothelium, but through the cement substance. Dr. Edmondson hoped that some investigational work may point the way to the control of retinitis.

D. Ophthalmic complications. Dr. S. Rodman Irvine stated that in general there was no need for worry in surgery on the diabetic patient. The degenerative disease of the arteries, veins, and cement substance, which allows blood to seep through the vessel wall, produces the surgical complications in diabetes, and not the diabetes itself. Hemorrhage at the time of surgery is not cause for concern compared to late hemorrhage. As had been previously pointed out the danger lies in hypo- and not hyperglycemia. Hemorrhages due to neovascularization of the iris and angle may be avoided by doing corneal sections in cataract extractions.

Postoperative iritis in diabetic patients, due to lowered resistance to infection, can usually be avoided by scrupulous care in cleansing the lids, and by giving antibiotics. Pseudoiritis, with an increased protein in the aqueous, is seen in diabetics and leads to adhesions of the vitreous face, iris bombé, and glaucoma. This is often due to hemorrhage in the posterior segment.

Hemorrhagic glaucoma is seen with increased intraocular pressure, deep chamber, aqueous flare, neovascularization of the iris, and proliferation into the angle. This is made worse by miotics, but improves with atropine. The condition is also seen in tumors, detachments of the retina, closure of the central retinal vein, and vitreous hemorrhage. It is found in diabetics in whom these complications are frequently present. The sequence of events is not definitely known, but a pathognomonic finding is a proliferation membrane on the iris, leading to ectropion uveae. The treatment required is usually enucleation since the other means of control are not successful. X-ray therapy of the globe, as for glioma, may control the neovascularization of the iris. It is well to remember that 8 percent of sympathetic ophthalmia cases follow operations upon blind, hemorrhagic, glaucomatous eyes.

Daniel B. Esterly,
Secretary.

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AVE ATQUE VALE

After 38 years of continuous and highly distinguished service to ophthalmology as chief editor of the *Archives of Ophthalmology,* Arnold Herman Knapp resigned his position on the 31st of December, 1948. Francis Heed Adler has been appointed his successor. The JOURNAL, with sadness, says "farewell" to the one, and, with good will, "hail" to the other.

The *Archives of Ophthalmology* has been of the utmost significance and importance to American ophthalmology during its long and valuable career. It was founded in 1869 by the retiring editor's eminent father, Herman Knapp, who arrived in this country from Germany, in 1868, at the age of 36 years and settled in New York. One year later, he and Prof. S. Moos of Heidelberg, Germany, established the *Archives of Ophthalmology and Otolaryngology.* The American edition was published by William Wood, and the German edition was published simultaneously in Carlsruhe by C. F. Muller.

In 1879 (Volume VIII), the two disciplines were divided into the *Archives of*

Ophthalmology and the *Archives of Otology*. The preface of Volume VIII of the *Archives of Ophthalmology* said, in part, "This division has been made, both for the convenience of many readers, who practice either ophthalmic or aural surgery exclusively, and for the sake of doing justice to the growing importance of the literature in both departments. The English and the German editions have hitherto contained the same original papers, either in the language of the authors or in faithful translations. This plan will be essentially continued; but if the contributions become too numerous, some papers will be abridged in the translation. . . .

"Profiting by their past experience and relying on a great number of prominent men as regular contributors, the editors feel assured of being able to furnish to their readers a *good journal*, presenting the actual state and progress of ophthalmic sciences and art in all their branches. In their selections the editors will give preferences to those original papers in which speculation and theory are subordinate to direct observation and fact. Their greatest gratification will be to hear their readers continue to say: 'What we read in your journal, we can make use of.'"

G. P. Putnam's Sons replaced William Wood and Co. as publishers with this (1879) issue and acted in this capacity until 1929 when the *Archives of Ophthalmology* was taken over by the American Medical Association.

The simultaneous American and German editions appeared quite regularly until 1921 when the umbilical cord was severed, and the *Archives of Ophthalmology* proceeded on an independent course. The arrangement had been a happy one for the American ophthalmologists in permitting them to keep abreast of the foreign contributions, especially German; and aided incalculably in the maturing of ophthalmology in this country.

Most of our ophthalmologists did not read German or French, and few had the means and the opportunity for foreign travel and experience in the great clinics abroad. Whether or not our colleagues overseas gained anything by the arrangement is questionable, for until World War II American ophthalmology was held pretty much in contempt as puerile and immature and perhaps uncouth by the Europeans.

Volume one, number one of the *Archives* has as its frontispiece, Tab. A. Fig. 1, a beautiful chromolithograph of a fundus painting by "H. Knapp. ad. nat. del." of a case of embolism of a branch of the retinal artery with hemorrhagic infarctus in the retina.

The first two articles are by B. A. Pope of New Orleans, the one on "Entopic Phenomena Connected with Circulation of the Blood," the second on, "Extirpation of the Fibrocartilage of the Upper Eyelids for the Cure of Certain Cases of Entropion and Trichiasis."

The third article was entitled a "Test-Type for Astigmatism," by Orestes M. Pray of Brooklyn who devised large letters composed of stripes running either vertically or horizontally. It looks like a good idea even at this distance in time. The contribution is poignant because of a footnote by "H. Knapp, Ed." who wrote "Shortly after the author had handed me, with a good deal of modesty, the Ms. of this his first—and unfortunately last—essay, he suddenly perished by a railway accident on Long Island. He was a talented and ambiable young physician, possessing a high degree of knowledge. All who knew him felt, with utmost regret, that a life had been destroyed which, preserved, would have had a share in the promotion of science for the benefit of suffering humanity."

In this same volume appeared an article by Elkanah Williams of Cincinnati on "Stricture of the Nasal Duct." His first sentence is of interest to us today. "The literature of lachrymal obstructions forms a

long and knotty chapter, in which every new method of treatment proposed, while promising the happy solution, has proved inadequate, and shared the fate of its predecessors."

Herman Knapp died on April 30, 1911. He had contributed over 150 articles to the *Archives*, many of them outstanding. There is no space here to give, in ever so brief a sketch, the biography of the Father of American Ophthalmology. His facets were many and all sparkled. E. Gruening, in writing his obituary, said: "As an editor, he would, on his own responsibility, correct erroneous and omit unscientific statements. This course sometimes gave rise to acrimonious correspondence, without, however, altering his ideal as to the necessity of maintaining the scientific standard of his publications."

Arnold Knapp assumed the position of chief editor of the *Archives* in January, 1911 (Vol. 40). His associate editors were W. A. Holden of New York, and C. Hess of Würzberg. He was 42 years of age and had already had a distinguished career and growing fame as an ophthalmic surgeon. So far as can be determined, his first appearance in print in the *Archives* was in Volume 28 (1899), with his paper, "A Case of Extensive Chronic Empyema of the Frontal and Ethmoidal Sinuses with Exophthalmos, Operation, Recovery."

In this volume, too, he reported a successful blepharoplasty operation and later showed five specimens of eyes enucleated after subchoroidal hemorrhage. The subsequent volumes of the *Archives* from 1899 onward show a steady flow of splendid contributions of articles and book reviews from his able pen.

While there was no change in the make-up of the *Archives*, one can detect a subtle change for the better in the selection of articles and editing from the moment Arnold Knapp assumed the editorship. His influence expanded, and authors considered it an honor to have their papers accepted by him. Fortunately for the JOURNAL, there were enough fine articles to support two ophthalmic publications during this time.

With the January, 1929, issue the *Archives* began a new series under the ownership of the American Medical Association, Chicago. The editorial board consisted of Arnold Knapp, chief editor; William Zentmayer, George S. Derby, Sanford R. Gifford, Francis Heed Adler, and John Herbert Waite.

There is no doubt that, while this action was of benefit to the *Archives* from an economic viewpoint, it proved to be harmful in the end from an editorial one, because of the geographical separation of the editorial offices and the overall control by the A.M.A.

Dr. Knapp found himself handicapped by this policy more and more as time went on, and especially during the war. The paper shortage forced the A.M.A. to curtail the size of its special journals and the *Archives* suffered severely from malnutrition. The climax came recently when, because of a prolonged printers' strike, the parent organization found it impossible to bring out the special journals anywhere near on time, and many numbers of 1948 are still in arrears.

Through these difficult years, Dr. Knapp struggled hard to keep interest in the *Archives* alive. On the other hand, the JOURNAL, more fortunately situated and independent, was successful in appearing promptly with increased size. This naturally influenced the authors of articles and contributions somewhat to the detriment of the *Archives*.

Thus, it is seen that Arnold Knapp deserves a well-earned rest from the arduous and difficult job of editor. That he has done a splendid work and wrought exceedingly well is attested to by the 53 volumes of the *Archives* that appeared during his regime. They form a monument to his labors and reveal the best in ophthalmology. It is with great regret that we see him relinquish this

task, but his laurels are firmly planted on his brow, and his fame and influence are assured. We wish him well in his retirement. One is consoled by the knowledge that contributions and book reviews will still appear in the *Archives* over his signature.

The new editor of the *Archives*, Francis Heed Adler, is a happy choice. He is known nationally and internationally as an author and editor of authority and prestige. In the first number of the new series of the *Archives* (1929) he has a translation of Albrecht von Graefe's classic article on "Iridectomy in Glaucoma," and an ophthalmic review on "Entopic Visibility of the Capillary Circulation in the Retina" which is particularly interesting in view of the first paper in the *Archives* by Pope alluded to before.

Dr. Adler's writings are numerous and important; his ophthalmic tastes catholic; and his judgment excellent. His ophthalmic ideals and integrity leave nothing to be desired. He has the good wishes from all ophthalmologists in his new venture.

With the growth of American ophthalmology and its assumption of leadership in this field, there is a need now, more than ever, for at least two national ophthalmic periodicals. A healthy competition between the *Archives* and the JOURNAL is desirable and in keeping with the policies of both boards to accept and print only the best that American ophthalmology can offer the world. There are enough, and often more than enough, worthy contributions to share between the two.

Ave Adler, Vale Knapp.

Derrick Vail.

PERIMETRY IN GLAUCOMA: A PLEA FOR BETTER INSTRUCTION

Several years ago, after an American Board of Ophthalmology examination, an editorial was published pointing out the appalling number of candidates who failed in perimetry. Many of them had very little conception of the principles involved and were unable to diagnose some of the simpler field changes.

At a recent examination given in Chicago at the time of the meeting of the American Academy of Ophthalmology and Otolaryngology, a review of the examination in perimetry brought out the fact that there had been an apparent improvement in some respects. The candidates, for the most part, were able to diagnose changes associated with lesions in the course of the optic-nerve fibers from the eye to the brain. The changes associated with diseases of the optic nerve were also fairly well understood.

In the perimetry of glaucoma, especially the early central field changes, many men had a very hazy conception of the pathology involved and the fields that were indicative of the disease. This involved not only the actual taking of the central field but also the theoretical knowledge associated with perimetry. Two candidates, when asked to make a drawing of the course of the optic-nerve fibers in the retina, showed the fibers starting in the fovea and spreading in all directions over the retina. This and other replies to questions indicated that many of the candidates did not understand the anatomy of the nerve fibers within the eye and did not know the significance of this in relation to the early central field changes encountered in glaucoma.

During the course of the practical examination in perimetry it was also apparent that many of the candidates had taken very few central fields. In some instances the fields in their offices were taken by technicians. If the ophthalmologist is unable to take a central field properly, he most certainly is not in a position to teach it to a technician or interpret the findings obtained.

If the ophthalmologist fails to find field changes in cerebral lesions, the condition is

usually found by the neurologist or neurosurgeon or the internist, as there are definite symptoms associated with these lesions. In glaucoma the responsibility rests entirely with the ophthalmologist. In chronic glaucoma there are no symptoms in the early stages, and glaucoma may be present before cupping is apparent. Therefore, in suspicious cases where the intraocular pressure is at the upper borders of normal, careful central fields are so often the deciding factor in the diagnosis.

At a meeting of the American Academy of Ophthalmology and Otolaryngology an excellent symposium was given on primary glaucoma by some of the leading ophthalmologists of this country.

In discussing the medical treatment of the disease, Scheie emphasized the importance of central field studies in watching the case and their place in the decision as to whether or not medicinal therapy, which was shown to be preferable, was sufficient to control the condition. When medicinal treatment is not adequate, early surgical interference is of utmost importance, and here again the properly done central field studies are the most important factors in making this important decision.

Dunnington, in his presentation of the surgical treatment of chronic simple glaucoma, also pointed out the importance of the central field studies in indicating the necessity of surgery. In addition, certain fields indicate that the surgical risk may be greater in a given case and that, therefore, all possible attempts should be made to avoid surgery.

In a personal discussion with Prangen, he stated that at the Mayo Clinic he has found central field changes many times before any other signs appeared in eyes that later were confirmed as being glaucomatous.

From the above it would seem self-evident that the competent ophthalmologist must be familiar with the earliest central field changes in glaucoma, such as depression in the field, baring of the blind spot, and the various early forms of the arcuate scotoma. In addition to knowing their significance, he must also be thoroughly familiar with the rather difficult technique of perimetry that reveals these often fleeting changes in the very early stages of this disease.

In the study of ophthalmology, the resident all too often is interested primarily in the surgical aspect of a given disease. He pictures himself as essentially an ophthalmic surgeon and is often surprised when entering private practice to find that there are also other nonsurgical aspects of ophthalmology that are of utmost importance.

A plea is made to all teachers of ophthalmology for better instruction in the study of glaucoma. In addition to the instruction in the medical and surgical care of this disease, the resident should receive adequate instruction in the pathology and anatomy underlying the changes produced by the disease. He should be thoroughly conversant with the course of the nerve fibers in the retina so as to be able to understand the early field changes that are characteristic. The only way of becoming proficient in the taking of central and peripheral fields is the experience of repeated perimetry on actual patients. To learn the technique properly it must be done under supervision until the instructor is certain that the technique has been mastered. It is hoped that this plea for better supervision in the teaching of perimetry will receive favorable consideration by our teachers.

Frederick C. Cordes.

CORRESPONDENCE

Provocative tests in glaucoma

Editor,
American Journal of Ophthalmology:

In his interesting paper entitled "The provocative tests in the diagnosis of the glaucomas" (Am. J. Ophth., **31**:1193 [Oct.]

1948), Dr. H. Saul Sugar presents the results he obtained with the diagnostic procedure he calls the pressor-congestion test, and which the late Dr. Robert K. Lambert and I named the lability test. The data he offers corroborate in the main our own published studies, but in his analysis of his results, a misinterpretation has occurred that has led to an erroneous conclusion.

In evaluating the response to this test, Dr. Sugar correctly quotes our original paper (Arch. Ophth., 34:83 [Aug.] 1945) in which the diagnosis of chronic simple glaucoma is considered strongly indicated "if the height to which the tension rose in the tested eye exceeded the normal limit of 30 mm."

Unfortunately, in the actual analysis of his results when the test was applied to 192 presumably normal eyes (page 1198), Dr. Sugar surprisingly falls into the error of considering tension response to a level of only 30 mm. Hg (Schiøtz) abnormal. Thus he reports 39 abnormal results in this normal group but among these he includes 18 eyes with tension elevations only to 30 mm.

Obviously, in conformity with the standard set in all our descriptions of the test and apparently adopted by Dr. Sugar for the purpose of his analysis, these latter 18 cases should not be considered as showing an abnormal response. Only in the remaining 21 eyes in which the tension rose to heights ranging from 31 to 33 mm. may the response be considered abnormal, according to our criteria. Thus the number of eyes in Dr. Sugar's normal series that apparently gave abnormal results with the lability test is actually 10.9 percent rather than 20.3 percent as was stated in his paper.

Furthermore, it should be noted that even this 10.9 percent exceeded the normal range of response to the test by only 3 mm. Hg or less. This variation of 3 mm. Hg, obtained with the Schiøtz tonometer, might properly be regarded as within the range of error of tonometry itself (Schiøtz, H: Brit. J. Ophth., 9:145 [April] 1925), and is not sufficient to reflect seriously on the test. This is particularly so since the heights of tension produced by this test in eyes with chronic simple glaucoma are in the great majority of cases distinctly higher than this borderline range. I am sorry that Dr. Sugar's paper did not include his results with glaucomatous eyes when evaluated on the basis of the height of tension produced by the test in each case. This is the criterion we have repeatedly emphasized as the most reliable for the lability test, and the one on which any appraisal of its value should be based.

In view of the foregoing, it seems to me that Dr. Sugar's results with the lability test when applied to normal eyes very closely approximate my own and those published by Dr. George T. Stine in the same issue of the AMERICAN JOURNAL OF OPHTHALMOLOGY that carried Dr. Sugar's paper (31: 1203 [Oct.] 1948). Such uniformity in the results of three independent investigators is noteworthy, and is further evidence of the reliability of the test.

In general, the diagnosis of chronic simple glaucoma is established by the proper evaluation of all the evidence in a case. The results of investigative procedures are not necessarily individually diagnostic but serve rather to supplement each other in the development of the complete clinical picture on which the diagnosis should be based. The results of the lability test when thus considered in conjunction with other data have proved of distinct value in the detection of chronic simple glaucoma.

(Signed) Sylvan Bloomfield,
New York, New York.

DR. SUGAR'S REPLY

Editor,

American Journal of Ophthalmology:

Dr. Bloomfield states that in the analysis of my results I misinterpreted the quotation of the normal limit of intraocular pressure which Bloomfield used and that this has led

to an erroneous conclusion. I should like to point out that this is not a misinterpretation but rather a difference in the interpretation of our standards. The conclusion remains unaffected.

Whether one uses 30 mm. Hg (Schiøtz) as the upper limit of the normal or as the lower limit of the abnormal depends entirely on one's experience with the tonometer he is using. Over a period of several years I have found a reading of 30 mm. Hg to be abnormal. In my paper I stated the exact number of those readings of 30 mm. Hg and each separate higher value so that no misinterpretation might result.

Even with elimination of the values of 30 mm. Hg, there are enough false positives with this test to preclude its complete reliability. The value of these tests lies in giving the clinician a method of determining with certainty that a patient with a borderline tension reading has or has not glaucoma. If even 1 in 10 are false positives, the clinician cannot be certain. The same is true for the other tests described in my paper. I must emphasize that in this work I had no axe to grind for or against any of the provocative tests, but aimed only at an evaluation of their reliability. Whether the standard of the abnormal is 30 or 31 mm. Hg does not change the conclusions drawn. From personal communications and the quotation by Kronfeld of Haas's findings during the recent Academy meeting (October, 1948), I believe that my values for the percentage of false positives will be found to be rather conservative.

Dr. Bloomfield states that a difference of 3 mm. Hg is within the limits of error of tonometry. While this is true, experienced clinical ophthalmologists must have a method of measuring intraocular pressure in which they have some confidence. The repetition of values by myself and my aides proved to me that the values were reliable as far as is humanly possible.

In the glaucomatous eyes of the series studied, I was surprised at the low number of positive results with the various tests. In the water test only 44 percent of unoperated eyes with simple (normal angle width) glaucoma showed a rise of over 9 mm. Hg. With the pressor-congestion or lability test, 13 percent showed a rise of over 9 mm. Hg, and with the combined water and pressor-congestion test, 37 percent showed a rise of over 10 mm. Hg.

The low number of positive results with the pressor-congestion test deserves some consideration. The rise in this test is transitory and, I believe, has a definite psychic factor, perhaps fear, associated with it. In patients who had never had any of the tests, or who were seen for the first time, the high values were more frequent, while those patients who were acquainted with us, and who had experienced tonometry and some of the other provocative tests, had fewer positive results. Most of the glaucoma patients in the series studied fall into the latter category. The other two tests which were studied involved the water test which is not of the same transient nature.

I believe the conclusions drawn in my paper are still valid, that the provocative tests are helpful in a minority of cases, and that none of the tests are of greater diagnostic value in questionable simple glaucoma cases than the practice of routine and repeated tonometric observations.

(Signed) Saul Sugar,
Detroit, Michigan.

Fat embolization involving the human eye

Editor,
American Journal of Ophthalmology:

In the May, 1948, issue of the American Journal of Ophthalmology, Dr. M. H. Fritz and Dr. M. J. Hogan report on "Fat embolization involving the human eye," saying that the only case known so far was reported by Evans in 1940.

I would like to inform you that, in 1933, I. Urbanek described such cases in a paper

entitled, "Ueber Fettembolie des Auges," in Graefes *Archiv für Ophthalmologie* (**131**: 147-173, 1933). The paper was amply provided with illustrations.

Should the authors have failed to notice this publication, they might have found information on this topic in the *Handbuch der speciellen pathologischen Anatomie*, Lubarsch-Henke, 1937, page 416.

(Signed) M. Radnót,
Budapest, Hungary.

DR. FRITZ'S REPLY

Editor,
American Journal of Ophthalmology:

Thank you for forwarding Dr. D. M. Radnót's letter concerning the article by Dr. Hogan and myself on "Fat embolization involving the human eye." Apparently, Dr. Hogan and I did not delve deeply enough into the literature or we would have discovered Dr. Urbanek's cases describing the same condition. I, myself, did not have the literature referred to at hand but Dr. Hogan was able to verify the references supplied by Dr. Radnót.

Even though the priority for describing this condition certainly belongs to the German workers, we still feel that the emphasis given to this condition by our article in the JOURNAL is deserved since it is not considered of frequent occurrence by general surgeons and by many ophthalmologists. We both regret that we failed to note and acknowledge the prior work of Dr. Urbanek.

(Signed) Milo H. Fritz,
Anchorage, Alaska.

PREDILECTION OF LEFT EYES FOR GLAUCOMA

Editor,
American Journal of Ophthalmology:

Only recently I came across Dr. Ascher's correspondence (Am. J. Ophth., **31**:234 [Feb.] 1948) on J. C. Holst's observation regarding the preference of glaucoma for the left eye (Am. J. Ophth., **30**:1267 [Oct.] 1947). May I be permitted to make a few remarks at this late date?

In the course of investigations concerning the right-left problem—one of the most fascinating chapters of biology—I had occasion to consider glaucoma and its preference for one side. The results did not seem clear enough to warrant publication. I doubt that Dr. Ascher's explanation of the preference of glaucoma for the left eye is acceptable.

Very early in the history of research concerning left-handedness the difference in the blood supply to the two hemispheres was taken into consideration to explain the preponderance of the left hemisphere in right-handedness. This hypothesis proved to be unworkable.

Theoretical reasons and experimental work showed that the blood pressure in the vessels of the right and the left side was, if present at all, too insignificant to explain the situation; a much more valid reason to abandon the idea was the realization that left-handedness would then only be explained by situs inversus—and the two conditions are, of course, not related at all.

I was inclined to suspect rather an anatomic or functional difference in the autonomous nervous system of the right and left body halves as responsible for any susceptibility of one eye to glaucoma.

Having now seen Dr. Holst's paper I don't know where we stand at all. According to his careful observations, the left eye is more prone to glaucoma—but in a series of several hundred of cases I got the impression that it was the right eye (in a proportion of 55:45 percent) which showed glaucoma earlier or more seriously than the left one! This disappointing situation is very familiar to anybody who has ever had the thrill of tackling an aspect of the right-left problem and makes it all the more attractive, if more difficult.

(Signed) H. J. Stern,
New York, New York.

BOOK REVIEWS

CLINICAL OPHTHALMOLOGY FOR GENERAL PRACTITIONERS AND STUDENTS. By H. M. Traquair, M.D., F.R.C.S., Ed. St. Louis, Missouri, C. V. Mosby Co., 1948. Clothbound, 258 pages, 72 illustrations, including 8 colored plates. Price, $9.00.

The book is an attempt to present ophthalmology in a "very restricted and elementary manner to undergraduates and to general practitioners whose primary aim is not a specialist training and who are not experienced in the use of special instruments and apparatus for ophthalmic examination, and to provide them with some assistance based simply on the care and common sense which the general practitioner is accustomed to employ." The object further expressed is not to instruct practitioners in the details of ophthalmology but to help them advise their ophthalmic patients.

Besides the chapters on the diseases of the eye, there are some excellent chapters on the physiology, including a brief and simplified discussion of physiologic optics, a chapter on the routine examination of the eye, and one on abnormalities of the eye. The chapter on therapeutics, in addition to simple therapeutic measures, discusses practical application of remedies, the methods of applying hot compresses, and the proper application of bandages and dressings.

In addition to being a good text for medical students, it occurred to me that it might be of great value to the nursing profession. A copy of the book was turned over to Ruth A. Lotspeich, R.N., in charge of the eye clinic at the University of California who reported the following:

"Dr. H. M. Traquair's *Clinical Ophthalmology* has proved very valuable in the short time it has been accessible to graduate and student nurses in the eye clinic.

"It is neither oversimplified, as are most nursing textbooks pertaining to the special senses, nor as technical as those books intended primarily for the use of the ophthalmologist. It is, therefore, an excellent source of teaching material in the preparation of conferences for student nurses, as well as being a reference book in which both the graduate and student nurse can find the clear description and definitions which enable her better to understand the treatment of the eye patient and the patient's reactions to examination and treatment by the oculist. Patient reaction to treatment and the conditions under which assurance may be given are carefully set down by Dr. Traquair, but are frequently omitted from textbooks for nurses as well as from ophthalmic texts. This book is also interspersed with guides to health teaching which assist the nurse in preparing herself for carrying out this important function.

"One must not be deceived by the lucid style and relatively easy reading into feeling that perhaps the absence of technical terminology detracts from the accuracy and pertinency of the material. Much factual information may be gained without an extensive medical vocabulary making this book an asset to the reader whose background in the physical sciences is somewhat limited.

"For these reasons, and because of the compactness of this book and the favorable comments of student and graduate nurses to whom it has been made available, it has proved indispensable as a teaching and reference book in the clinic."

The format is up to the usual Mosby standard. The black and white illustrations are excellent and the colored plates are well chosen.

Frederick C. Cordes.

DAS HAFTGLAS ALS OPTISCHES INSTRUMENT. By E. Bürki, Privatdozent für Augenheilkunde an der Universität Basel. Basel, Switzerland, S. Karger, 1948. 322 pages, 80 diagrams, 4 plates, 19 tables, index, and bibliography. Price, not listed.

Bürki, a disciple of A. Brückner, the celebrated Swiss authority on physiologic optics, presents the first comprehensive text on contact glasses written by an ophthalmologist in any language. The theoretical section of the book, as implied by the title, treats contact glasses in the same manner that Von Rohr considered spectacles in his classic "Das Brillenglas als optisches Instrument."

The fascinating optical implications of contact glasses are assiduously inspected from every possible facet. Fifty pages are devoted to the elaboration of formulas for telescopic combinations of contact glass and spectacle lens. The mathematics throughout are fairly simple and are clarified by detailed application to specific problems.

Bürki is optimistic about future technical improvements in contact glass fitting. (And even before his book reached publication, a radical departure—the fluidless plastic corneal lens—was developed by the College of Medical Evangelists of the U.S.A. and is now commercially available.)

The clinical aspects of contact glasses are discussed in gratifying detail. Plexiglass (methylacrylate), introduced by Thier of Holland, has superseded glass, although it is 10 times more sensitive to scratching and becomes greasy with excessive meibomian secretion. On the other hand, the plastic has but half the weight of glass, is flexible, unbreakable, more transparent, and not corroded by tears. A mold need no longer be routine. About 80 percent of patients can be fitted from an adequate test set with only some slight adjustment.

Contact glasses should have a much greater field than the correction of refractive errors and keratoconus. They may help cases of corneal opacities and corneal transplantation by overcoming residual irregular astigmatism. Tinted contact glasses are more efficient than sunglasses in preventing dazzling in albinism and aniridia.

In the chronic keratitis due to mustard-gas injury, the contact glass lessens the tendency to recurrent exacerbations and is well tolerated. It is likewise a valuable therapeutic aid in keratitis neuroparalytica, lagophthalmos, entropion, and trichiasis. The contact glass may help in preventing symblepharon and, with a ledge above the corneal portion, can serve to keep the lid up in ptosis. Filled with ointment the contact glass permits constant medication to the cornea. Bürki's book indicates that an increasing interest in the subject by ophthalmologists is imperative if the contact glass is to attain its full possibilities.

James E. Lebensohn.

TRANSACTIONS OF THE OPHTHALMOLOGICAL SOCIETY OF PARIS (and of the Ophthalmological Societies of the East, of Lyon, and of the West). Meetings of November-December, 1947, pp. 421-659.

This volume contains the reports of the scientific sessions and business meetings of the Société français d'ophthalmologie de Paris in November and December, 1947, as well as the reports of the meeting of the Société d'ophthalmologie de l'Est at Luxembourg in June, 1947, and the session of the Société d'ophthalmologie de l'Ouest at Nantes in the same month.

The most important item of the November business meeting was the unanimous approval of Offret's suggestion to publish a joint bulletin on the activities of all the ophthalmological societies in France under the title, "Bulletin des Sociétés d'ophthalmologie de France."

In the scientific session of November, A. de Gramont developed and explained his ideas on the color perception of the external world. These ideas are neither absolutely contradictory nor especially similar to the teachings of Young. A. de Gramont explains the mechanism of the reception and transmission of the stimulus; Young, the composition of the primary sensation.

A. de Gramont assumes that the light

acts like an electromagnetic wave and stimulates special elements in the external part of the cones and rods. The originating current is believed to end in a certain number of receiving elements, probably five, and to produce the elementary color sensation.

A collective review of the previously published paper on the physiopathology of the eyes in aviators was presented by A. Mercier and J. Duguet.

Eight papers were read at the meeting in December. Joseph and Offret discussed corneal transplants. Dollfus, Taptas, and Brisach reported a case of intracranial arteriovenous aneurysm with complete bilateral ophthalmoplegia. Polliot and Taptas discussed a case of optic atrophy caused by direct compression of the end of the cavernous sinus by the dilated internal carotid.

Dollfus described the abolition of the direct and consensual light reflex in traumatic compression of the optic nerve with partial return of vision. Schiff-Wertheimer and Jonquères observed a severe glaucoma attack that occurred immediately after a subconjunctival injection of adrenalin (1:1,000). Duguet presented an interesting study of the effect of anoxemia on heterophorias and its use in the evaluation of the qualifications of pilots. Farnarier reported on the use of dried amniotic grafts in ocular burns, and Sedan showed a new spatula to preserve and hold corneal grafts.

A symposium on the treatment of glaucoma in the presence of cataract was the feature of the June meeting of the Society of the East. Thomas, L. Weekers, R. Weekers, Thibert, Duverger, Bregeat, Sourdille, Dejean, and Gassenc discussed various surgical procedures, medications, and numerous problems.

During the meeting of the Society of the West, nine papers were presented. Sourdille talked on the pathogenesis and treatment of convergent concomitant squint. Blum read a paper on aniseikonia. Lacroix discussed penicillin treatment of sympathetic ophthalmia. Sedan reported a study on fistulating scars, and Offret and Harvouet one on retinal periphlebitis.

Rousseau spoke on traumatic paralysis of the abducens. The indications for total lamellary corneal grafts were reviewed by Sourdille. Pesume referred to the importance of early surgery in infantile glaucoma and considered the operation of choice to be Elliot's trephining operation.

Alice R. Deutsch.

ERRATUM

In the paper, "The functional organization of the third-nerve nucleus in the cat," by Dr. Pierre C. Danis, published in the September, 1948, issue, the following author's erratum appears in paragraph three of the summary on page 1130: "3. The functional organization of the third-nerve nucleus follows the following plan, going from the caudal to the rostral end: . . ."

It should read: "3. The functional organization of the third-nerve nucleus follows the following plan, going from the *rostral* to the *caudal* end: . . ."

ABSTRACT DEPARTMENT

EDITED BY DR. F. HERBERT HAESSLER

Abstracts are classified under the divisions listed below. It must be remembered that any given paper may belong to several divisions of ophthalmology, although here it is mentioned only in one. Not all of the headings will necessarily be found in any one issue of the Journal.

CLASSIFICATION

1. Anatomy, embryology, and comparative ophthalmology
2. General pathology, bacteriology, immunology
3. Vegetative physiology, biochemistry, pharmacology, toxicology
4. Physiologic optics, refraction, color vision
5. Diagnosis and therapy
6. Ocular motility
7. Conjunctiva, cornea, sclera
8. Uvea, sympathetic disease, aqueous
9. Glaucoma and ocular tension
10. Crystalline lens
11. Retina and vitreous
12. Optic nerve and chiasm
13. Neuro-ophthalmology
14. Eyeball, orbit, sinuses
15. Eyelids, lacrimal apparatus
16. Tumors
17. Injuries
18. Systemic disease and parasites
19. Congenital deformities, heredity
20. Hygiene, sociology, education, and history

1

ANATOMY, EMBRYOLOGY, AND COMPARATIVE OPHTHALMOLOGY

Chacko, L. W. **An analysis of fibre-size in the human optic nerve.** Brit. J. Ophth. **32**:457-60, Aug., 1948.

The author measured consecutive fields of optic nerve fiber preparations. An Abbé camera lucida was used to superimpose the image of a scale with lines of graded thickness.

The optic nerve contains fine, closely packed, myelinated fibers without Schwann sheaths. They vary in size from 0.7 μ to 8.0 and occasionally 10.0 μ in diameter. The greatest frequency of diameter of the fibers is under 1.0 μ and the next from 1.0 to 2.0 μ.

The histogram of the fiber caliber corresponds roughly to that of somatic motor and sensory nerves, but is closest in range and frequency to visceral nerves. The increase in the number of fine fibers of the optic nerve appears to be consequent on the differentiation of central vision. Orwyn H. Ellis.

Magitot, A. **The opto-tangential nervous route.** Ann. d'ocul. **181**: 423-427, July, 1948.

Dollander's superb contribution on this subject in which he reports experiments on guinea pigs is analyzed. A bilateral neural connection of the hypophysis with paraventricular and supraocular centers, which are in close proximity to the third ventricle, is described. The hypophysis is in turn connected with the superficial cervical ganglion. These synapses facilitate a better understanding of the neurovegetative functions associated with degeneration and regeneration in some visual and hypothalamic diseases. Among the conditions involved are the pigmentary reflexes which are involved in retinal pigmentary degeneration and which are frequently associated with pituitary and gonadal degeneration. Possibly also involved are photoglucide reflexes which may be involved in some diseases of the liver and the hypophysis.

Chas. A. Bahn.

Michaelson, I. C. **Vascular morphogenesis in the retina of the cat.** J. Anat. **82**:167-174, July, 1948.

This paper describes the development of the blood vessels of the retina in the cat. From the observations on 5 fetuses, 14 kittens and 3 cats an attempt is made

to explain the occurrence of the capillary-free zone.

Vessel growth in the retina of the cat is by a process of budding from pre-existing vessels. No evidence is found of vascular differentiation from local cells. The formation of retinal capillaries is pre-eminently a function of the retinal veins. Only the arteriae afferentes appear to originate from arteries. The spread of capillary growth towards an artery extends for only a certain distance, leaving a well-marked capillary-free space around the arteries similar to that present in other mammalian retinae such as those of rat, dog, pig and man. The present study of ontogeny shows that the bulk of the capillary system in the retina of the cat can be considered as part of the venous system. The arterial system is shown to be supra-capillary. (17 References.)

Donald T. Hughson.

Sondermann, R. **Research in developmental anatomy and the eye.** Arch. f. Ophth. **148**:331-337, 1948.

The author emphasizes the similarities which can be found in the development of the venous drainage of the eye and the brain. The narrowing of the venous outlets in the developing eye and brain capsules is considered one of the decisive factors in the production of the high venous pressure of these organs. Since the weight of the embryonic human heart at the end of the second month equals one tenth of the total body weight of the embryo, its tremendous force is regarded as another factor which determines the venous and intraocular pressure. Ernst Schmerl.

Wood, E. H. **Normal optic nerve. 1. Classification of the optic disc based on branching of the central retinal artery.** Arch. Ophth. **39**:305-312, March, 1948.

There are several definite and easily recognizable variations in the distribution of the vessels as they emerge from the optic nerve head. The classification is made by dividing the surface of the nerve head into four quadrants. Since there are four main branches of the retinal artery, namely, the superior and inferior temporal and the superior and inferior nasal, there are nine possible variations in the distribution of these vessels over the surface of the optic nerve head. There is also a tenth class, in which the vessel does not follow the quadrant distribution. The distribution of the veins is disregarded in the make-up of this classification. A statistical analysis of 500 eyes, based on this classification, is shown.

It is extremely rare to find either the upper or the lower nasal quadrant devoid of main branches of the central retinal artery. No case has been found in which the whole nasal half of the disc was devoid of the main branches of the central retinal artery. Less than one-half the 412 subjects studied had optic disks which were in the same class. The arterial pattern of the eyegrounds can be recognized at least up to three hours after death. The central artery of the retina emerges from the disc on the nasal side of the central vein in a large majority of all eyes.

Ralph W. Danielson.

2

GENERAL PATHOLOGY, BACTERIOLOGY, IMMUNOLOGY

Hall, W. K., Bowles, L. L., Sydenstricker, V. P., and Schmidt, H. L., Jr. **Cataracts due to deficiencies of phenylalanine and of histodine in the rat. A comparison with other types of cataracts.** J. Nutrition **36**:277-296, Aug. 10, 1948.

A brief resume of the discovery that cataracts could be attributed to nutritional deficiency is given. Wistar strain rats were fed deficient diets and examined with the biomicroscope three or four

times a week. Some rats were killed and others were permitted to die of the deficient diet. The routine use of atropine to dilate the pupils resulted in more extreme keratitis than did the occasional use of atropine.

In rats deficient in phenylalanine, histidine, tryptophane and riboflavin the lens became generally hazy, with separation of the superficial fibers. There was a widening of the sutures and granular opacities appeared in the cortex. A refractile line appeared to separate cortex and nucleus. Some lenticular changes appeared in protein deficiency. Lens changes also appeared in diets deficient in certain essential amino acids. Diets deficient in arginine did not cause cataracts. When rats deficient in phenylalanine or histidine were returned to the control diet, a reversal of superficial changes resulted, though the dense nuclear opacities were found to be irreversible.

The occurrence of cataract in a rat on a high tyrosine diet, and of spontaneous cataracts in two litters of rats is described. A table summarizes the corneal and lenticular changes observed in young rats deficient in protein, amino acids or riboflavin. (27 figures, 1 table.)

H. C. Weinberg.

Harrell, G. T., Reid, C. H., Little, J. M., Mankin, J. W., Pittman, H. W., Holt, L. B. and Morris, L. M. **Effect of roentgen therapy on experimental ocular vaccinia in nonimmune and in partially immune rabbits.** Arch. Ophth. **39**:313-324, March, 1948.

Accidental ocular infection with vaccinia occurs usually as a complication of prophylactic immunization against smallpox. The danger of ocular infection lies in involvement of the cornea, with subsequent development of an opaque scar. The experiments reported were suggested by the beneficial results obtained from the use of roentgen therapy for an accidental ocular infection in a partially immune human being. The authors conclude that roentgen therapy appeared to be of value in the treatment of acute lesions of ocular vaccinia in experimental animals.

Ralph W. Danielson.

Loewenstein, A. **Double staining for bulk specimens of retina and choroid.** Brit. J. Ophth. **32**:748-753, Oct. 1948.

The author describes his technique for double staining of bulk specimens of the retina with hematoxylin and Sudan IV. The superficial and deep capillary network, and variations in caliber of the vessels, especially in vascular retinal diseases, are clearly visible. Pathologic anastomoses, aneurisms, subendothelial necrosis, and exudates in the retina may be studied. The choriocapillaris and changes in the choroidal vessels may be carefully examined. The author recommends the technique because it is simple, and does not require laboratory facilities. (3 photomicrographs.)

Orwyn H. Ellis.

Marchesani, O. **The problem of endogenous inflammations of the eye.** Arch. f. Ophth. **148**:187-215, 1948.

The part played by nervous mechanisms and disturbances in the development of so-called endogenous inflammations is discussed. To explain his views the author uses the clinical pictures of cyclitis with heterochromia and cataract, keratitis neuroparalytica and sympathetic ophthalmia. His basic idea is that the allergy which underlies these diseases is not an antigen antibody reaction but rather a neural allergy of the autonomic nervous system produced by a summation of stimuli. Reference is made to Speransky: A Basis for the Theory of Medicine, Philadelphia 1942.

Ernst Schmerl.

3

VEGETATIVE PHYSIOLOGY, BIOCHEMISTRY, PHARMACOLOGY, TOXICOLOGY

Alves Ferreira, R.-J. **Penicillin in ophthalmology.** Rev. brasil. oftal. **6**:219-230, June, 1948.

Failures attributed to the use of penicillin in ophthalmology are blamed by the author on impure penicillin, as well as on the fact that many endocular affections are not properly bacterial but toxic or allergic. Ointments of penicillin should be so made that each gram of ointment corresponds to 100,000 units of pure penicillin without being dissolved previously in water. W. H. Crisp.

Ball, S., Collins, F. D., Morton, R. A., and Stubbs, A. L. **Chemistry of visual processes.** Nature **161**:424-26, March 20, 1948.

The article describes experiments which help to clear up the different known opinions on the chemical nature and physiological properties of rhodopsin (visual purple). Francis M. Crage.

Bellows, J. G., and Farmer, C. J. **The use of bacitracin in ocular infections. Part II. Bacitracin therapy of experimental infections.** Am. J. Ophth. **31**:1211-1216, Oct., 1948. (1 table.)

Braley, A. E., and Sanders, M. **Aureomycin in ocular infections.** J.A.M.A. **138**:426-427, Oct. 9, 1948.

An antibiotic has recently been derived from a mold belonging to the Streptomyces group, at the Lederle Laboratories. It was used on 100 patients, administered mostly as a 0.5-percent solution of the borate salt in isotonic salt solution. The solution, pH of 7.5 to 7.8, was mildly irritating to the inflamed eye and nonirritating to the inflamed conjunctiva. In solution at room temperature the activity of the drug disappears in about 24 hours. It was found effective against staphylococcic, pneumococcic, influenza and inclusion conjunctivitis and also in cases of Mooren's ulcer and atypical Mooren's ulcer of unknown cause. In epidemic keratoconjunctivitis it has some effect provided treatment is started before the fourth day of the disease. It may be of value in dendritic keratitis. The authors consider it a valuable addition to our antibiotics. Bennett W. Muir.

Capello, Herros. **The visual manifestations of Tridione.** Arq. brasil. de oftal. **11**:78-89, 1948.

The author reviews the literature with regard to toxic reactions from Tridione, or trimethyloxazolidine, an analgesic and anticonvulsive, which has been used by various workers to control epilepsy. Secondary effects reported include cutaneous eruptions, gastric irritation, and ocular phenomena in the form of hemeralopia, photophobia, and hypersensitivity to light. One case has been reported of a death from aplastic anemia following use of this drug in association with hydantoin. It is possible that the drug inhibits oxidation of the visual purple, and it is suggested that experimental use of the drug may contribute to the elucidation of problems regarding certain visual phenomena. (References.)
W. H. Crisp.

Davson, H., and Duke-Elder, W. S. **The distribution of reducing substances between the intraocular fluids and blood plasma, and the kinetics of penetration of various sugars into these fluids.** J. Physiol. **107**:141-152, March, 1948.

In the cat and rabbit, the glucose concentrations in the aqueous humor and vitreous body are lower than would be

expected on the basis of a simple diffusion equilibrium with the plasma. Experiments indicate that the metabolism of both lens and retina causes this glucose deficit.

The rates of penetration of glucose, galactose, 3-methyl glucose, xylose, and sucrose into both aqueous humour and vitreous body of the cat's eye have been measured and constants, proportional to these rates, have been calculated. Sucrose penetrated the aqueous humour much more slowly than the other four sugars. With the vitreous body the penetration rates were consistently smaller and an analysis of the results indicates the existence of a more selective barrier to diffusion into this part of the eye than that separating the aqueous humour from the blood. The possible physiological significance of this difference is discussed and the importance of including the vitreous body in any study of intraocular dynamics is stressed.

The rate of penetration of sugars into the aqueous humour seems to be independent of pupil size and it seems likely that the bulk of diffusion into the anterior chamber takes place from the iris. Some evidence is presented which suggests that the locus of diffusion into the vitreous body is not confined to the ciliary body. By assuming limiting values for the area-to-volume relationship for the aqueous humour, it is possible to calculate the true permeability constants for the hexoses in the conventional units; the computation suggests that penetration is rapid in comparison with that of analogous, lipoid-insoluble molecules diffusing into plant cells.

Theodore M. Shapira.

Duane, T. D. **The respiration of the stored cornea.** Am. J. Ophth. **31**:1400-1404, Nov., 1948. (6 figures, 15 references.)

Duke-Elder, Stewart. **Nature of the aqueous humor.** J.A.M.A. **137**:1285-1288, August 7, 1948.

The author is certain that the aqueous is not completely described by the mathematical formulation for a dialysate nor is it, in the generally accepted sense of the word, a secretion.

There is a free and full transference of water reciprocally across most of the blood-aqueous barrier. Half-renewal of the aqueous every three minutes is probably correct. This transference normally occurs to a large extent through the iris. The author is not convinced about the unidirectional permeability of the ciliary region. There is a through and through current at the canal of Schlemm, probably 0.5 cc. per minute. No entirely satisfactory theory of the aqueous metabolism exists.

R. Grunfeld.

Escapini, Humberto. **Degeneration and regeneration of nerves in corneal transplantation.** Arch. Ophth. **39**:135-161, Feb., 1948.

This paper is based on experimental studies of nerve changes in the rabbit cornea after transplantation. The corneal nerves behave like any peripheral nerve after its severance, showing regressive changes followed by regenerative ones. In cases of corneal transplantation, degenerative changes develop in the nerves of the host and of the graft. The nerves in the host degenerate in an area 2 mm. wide around the graft. In the graft, the nerves represent the distal stump of the severed corneal nerves and undergo Wallerian degeneration at a slow rate. Reinnervation of the graft is accomplished by new nerve fibers which sprout from the nerves of the host all around the graft. Physiologic tests of the graft begin to yield a response 45 days after the operation; the intensity of this response gradually increases but never reaches the

normal threshold of corneal sensitivity. Nine months after operation the sensory recovery has not yet reached the normal level. Detailed histological studies of the nerves were made. John C. Long.

Esente, Ivan. **Antiglaucomatous drugs and neurohormonal chemical intermediaries.** Giorn. ital. di oftal. 1:147-164, March-April, 1948.

The author reviews the pharmacologic and therapeutic properties of drugs that reduce ocular tension. He establishes several general biochemic principles. The action of the neurohormonal chemical intermediaries depends not only on the dosage used, but also on the condition of the individual and the state of irritability and reaction of the vegetative nervous system, both centrally and peripherally. Through the neurohormonal chemical intermediaries it is possible to reach the vegetative nervous system at its periphery or centrally. It is to be decided whether it is preferable to reinforce the neurohormonal chemical intermediary locally or through systemic medication. Francis P. Guida.

Gardiner, P. A., Michaelson, I. C., Rees, R. J., and Robson, J. M. **Intravitreous streptomycin: its toxicity and diffusion.** Brit. J. Ophth. 32:449-56, Aug., 1948.

Streptomycin in the vitreous acts as a depot and chemotherapeutic concentrations are maintained in the ocular fluids for over three days. Its diffusion is, therefore, slower than that of penicillin. Subconjunctival injection produces a chemotherapeutic level for only a few hours. In toxicity experiments intravitreous streptomycin was found to produce destruction of cellular elements and occasionally retinal detachment. The data on toxicity are at variance with those of other authors, but these experiments suggest caution in the intravitreous use of streptomycin. Orwyn H. Ellis.

Gardiner, P. A., Michaelson, I. C., Rees, R. J. W. and Robson, J. M. **The effects of various types of penicillin injected into the vitreous.** Brit. J. Ophth. 32:768-775, Oct., 1948.

The toxic effects of various types of penicillin injected into the vitreous were studied. Localized patches of retinal destruction resulted and the initial effect was especially on the rod and cone layer. Penicillin G and mixed penicillin were found to be less toxic to the retina than penicillins X, F, K and dihydro F. No material difference in the rates of diffusion of the various types was found, except that penicillin K diffuses more slowly. The rates were similar to those of mixed penicillin. Orwyn H. Ellis.

Kennedy, J. D., Woods, A. C., Buckley, J., Berthrong, M., and Burky, E. L. **Experimental studies of ocular tuberculosis. IX. Failure of penicillin to affect the course of experimental ocular tuberculosis.** Arch. Ophth. 39:261-266, March, 1948.

The authors review the literature which indicates that penicillin is without clinical effect upon tuberculous infections. After describing their own experiments with a large number of animals, they conclude that large doses of calcium penicillin G (200,000 units per day, equivalent in amount to 5,200,000 units for a man weighing 65 Kg.) had no significant effect on experimental ocular tuberculosis in the nonimmune rabbit. Ralph W. Danielson.

Mayer, L. L. **Sodium sulfacetimide in ophthalmology.** Arch. of Ophth. 39: 232-239, Feb., 1948.

The author recites his experience in treating approximately 3,000 cases of acute and chronic conjunctivitis with a 30-percent solution of sodium sulfacetimide. In many cases of bilateral conjunctivitis controls were carried out, one eye

treated with sodium sulfacetimide and the fellow eye with some other agent. The average mean periods of recovery for the various methods for all the cases were as follows: without medication, seven days; with 1-percent silver nitrate, six days; with 2-percent silver nitrate, five days; with 10-percent mild silver protein, (argyrol), eight days; with 20-percent mild silver protein, seven and a half days; with hexylresorcinol, 1:2,500, five days; with nitromersol (metaphen) 1:5,000, five days; with nitromersol, 1:2,500, four and a half days; with ethyl hydrocupereine, 0.5-percent, four and a half days; with zinc sulphate, 0.5-percent, five days; with mercuric oxycyanide, 1:3,000 seven days; with benzylkonium chloride (zephiran), 1:1,000 eight days, and with 30-percent sodium sulfacetimide, three days. No case of sensitization to the sodium sulfacetimide was observed. The author regards this drug as an ideal antiseptic in cases of acute and chronic infection of the conjunctiva.

John C. Long.

Pereyra, Lorenzo. **First clinical investigations on the action of dihydroergotamine (DHE 45) in ophthalmology.** Giorn. ital. di oftal. 1:165-171, March-April, 1948.

In the normal eye "DHE 45" produces a slight and transitory hypotonicity, a slight rise in the retinal arterial pressure and no change in the diameter of the pupil. In chronic glaucoma it has a beneficial effect on the pupil and the ocular pressure, and in acute glaucoma even on the pain. It reinforces the action of the miotics. In cases of herpes zoster "DHE 45" as the only therapeutic agent produced brilliant results. There was no benefit noticed in herpetic keratitis and in keratitis epidemica. Best results were obtained by the use of one or two injections intramuscularly followed by 20 drops, one to three times each day. It is best to find the optimum dosage by starting with small doses. Even after prolonged use there was never any manifestation of toxicity or intolerance.

Francis P. Guida.

Rubino, A. and Esente, I. **The eye and the diencephalon.** Riv. oto-neuro-oftal. 23:149-169, May-June, 1948.

The authors investigated the "photoglycemic reflex" in twenty subjects. A glucose test was done in the dark and in the light in order to determine whether the luminous stimulus on the retina could influence the metabolism of carbohydrates. The results of their experiments led the authors to think that the photoglycemic reflex is a result of anatomic and functional correlation of the retina and the diencephalon. (4 figures, references.) Melchiore Lombardo.

Simonelli, M., and Andreani, G. **Ocular manifestations in experimental diabetes due to allosan.** Giorn. ital. di oftal. 1:132-134, March-April, 1948.

Six rabbits were injected with a 5-percent solution of allosan, 200 mgm. per kg., to produce diabetes. Of the six, three died very early, and three became diabetic. After four months, one rabbit showed early subcapsular opacities which progressed to resemble a coronal cataract. The other two rabbits have not shown any diabetic ocular changes. Further reports will be made on the histologic findings after continued observation of these animals. Francis P. Guida.

4

PHYSIOLOGIC OPTICS, REFRACTION, COLOR VISION

Amoretti, E. **The plastic contact lens.** Rev. oto-neuro-oftal. 23:5-6, Jan.-March, 1948.

The author claims that the plastic con-

tact lens is the best way to exactly correct the majority of refractive errors, that the molded contact lens is the best type, that extreme care must be exercised in taking the mold, that both spheric and toric types may be employed, and that it is especially indicated in keratoconus.

Edward Saskin.

van Beuningen, E. G. A. **A normal curve of depth perception for clinical purposes.** Arch. f. Ophth. **148**:269-276, 1948.

The author used the stereoeidometer and studied the depth perception of 1200 persons with varying visual acuity. The critical angle varied from 4° to 14° for visual acuities from 20/10 to 20/30.

Ernst Schmerl.

Chance, Burton. **Tests of defective color vision.** Arch. Ophth. **39**:162-172, Feb., 1948.

The author presents a general discussion of the problems of defective color vision and describes methods of detecting the defects. Among the various tests for color perception he discusses the Thompson stick, the Williams lamp, the Eldridge-Green lamp, the Ishiara, Stilling, Rabkin and American Optical plates, and several skein tests. The various advertised cures for color blindness depend upon teaching the patient to memorize the test plates. Despite the growing interest in the examination of persons who are believed to be normal, no new facts have been discovered in recent years which will aid in the solving of the problem of color vision.

John C. Long.

Cohen, Jozef. **Color adaptation to stimuli of different spectral composition but equal tristimulus values.** Science **108**: 159-160, August 13, 1948.

By experimental investigation the author proved that the color adaptation phenomenon is a function of the tristimulus values of the stimulus and not of the spectral composition of the stimulus. The eye fails to resolve a stimulus into its components even under the most elaborate experimental conditions.

R. Grunfeld.

Cotlier, I. **Considerations of the different methods for studying astigmatism.** An. argent. de oftal. **8**:1-10, Jan.-Feb.-March, 1947.

This is an exhaustive review of the contributions of Rossler, van den Bergh, Trantas, Lindner, and others, to the study of astigmia, and its determination by subjective and objective means. (Bibliography).

Edward Saskin.

Flamant, F., and Stiles, W. D. **The directional and spectral sensitivities of the retinal rods to adapting fields of different wave-lengths.** J. Physiol. **107**:187-202, March, 1948.

The absolute parafoveal threshold for a monochromatic test stimulus is nearly independent of the angle of incidence of the light on the retina for wave-lengths below 600 μ, but exhibits a marked directional effect in the red. It does not follow that the response of the parafoveal rod mechanism becomes directional in the red, because in this spectral region cone vision, which is highly directional, may be participating. By determining the extent to which the threshold for a blue test stimulus is raised by adapting fields of different wave-lengths, incident on the retina at different angles, it is shown that the rod response to an adapting field is nondirectional, or nearly so, for all colors of the field. It is also shown that the relative spectral sensitivity of the rod mechanism is the same whether determined by the direct threshold method or indirectly from the adapting effect of the field. For one subject, the measurements indicate that the retinal end-organs, in the parafoveal area used, point towards

the edge rather than toward the center of the pupil. The results suggest that the rods may show a directional response when the retinal angle of incidence can be increased beyond the limit normally set by the pupil. Theodore M. Shapira.

Granit, R., and Tansley, K. **Rods, cones, and the localization of pre-excitatory inhibition in the mammalian retina.** J. Physiol. **107**:54-66, Jan., 1948.

This paper is concerned with the relationship between the amounts of excitation and inhibition produced at the threshold of stimulation for the receptors of the cat retina as well as how these two processes are related to the reactions of the rods and cones.

The micro-electrode technique was applied to the analysis of the reactions of 100 isolated retinal elements in the dark-adapted cat. Equivalent stimulus values for the dark-adapted eye for a red (0.650 μ) and a blue (0.460 μ) wave length were obtained by applying a correction factor based on the sensitivity of visual purple and the energy distribution of the colorimeter lamp. If, after this correction has been applied, threshold sensitivity to red is equal to that for blue (R = B) then the reactions of the element in question must be dominated by visual purple. If R is greater than B then the red-sensitive receptors (cones) must determine the reactions and if R is less than B blue-sensitive receptors must be active in the element. By measuring the R/B ratio for pure on-elements and pure off-elements, it has been possible, for the authors to demonstrate that the pure on-elements are dominated by rods—and that the cones are present in a great majority of both on-off-elements and pure off-elements. Blue-sensitivity was restricted to the pure on-elements. The off/on ratio was measured for the on/off-elements. Since the occurrence of an off-effect is evidence of preceding inhibition the off/on ratio is a measure of inhibitory activity just as the R/B ratio is a measure of cone activity. The authors found that the appearance of inhibition was associated with the presence of cones.

The results have made it possible to formulate four conditions which must be satisfied by any retinal structure postulated as responsible for the inhibitory system. These conditions are best satisfied by the amacrine cells, possibly in combination with the horizontal cells. The off/on ratio showed a variation of 1 to 100,000. The extent of this variation is considered to be of fundamental importance for visual discrimination. It must also be taken into account in any consideration of the localization of inhibition in the retina. The R/B ratio for the on-off-elements varies from 1 to 50 despite the limited absolute number of cones, so that the retinal element must either contain a large number of receptors or the cones must be able to inhibit the rods within the same element.

Theodore M. Shapira.

Granit, Ragnar. **Neural organization of the retinal elements, as revealed by polarization.** J. Neurophysiol. **11**:239-252, May, 1948.

The observation that the off/on-elements, isolated by the mico-electrode technique in the cat's retina, formed two symmetrically organized structures responding similarly to the opposite poles of a polarizing current but in an opposite fashion to identical poles, was expanded by Gernandt and Granit into an analysis of pure on-elements and pure off-elements and an attempt to correlate polarity and off/on-ratio at the threshold of illumination. In the present phase of the author's work polarization analysis and measurements of off/on-ratios are among the most important tools for penetrating further

into questions concerning the functional organization of the retina.

With reference to a pair of electrodes in the nasal and temporal corners of the eye, the fully dark-adapted retinal elements of the cat are "anodal" or "cathodal", that is, stimulated either by the make of the anode or the make of the cathode and depressed by the opposite pole. Depressions are succeeded by off-effects at the break of the current. Simultaneous records of adjacent anodal and cathodal on/off-elements show that depression of the one may coincide with excitation of the other.

The light thresholds of pure on-elements, studied with currents of rheobasic strength as great as 60 times the rheobase, do not change very much under the influence of the electrical currents. The light thresholds of the anodal on/off-elements can easily be suppressed by cathodal polarization, particularly at "off." Most cathodal on/off-elements behave like the pure on-elements. Their light thresholds are relatively insensitive to polarization. A smaller group behaves like the anodal on/off-elements, but with reversed polarity. Sometimes very great facilitations of the light threshold can be obtained in on/off-elements. The large inhibitions and facilitations are initiated by specific structures, often independent for the on- and off- component of an off/on-element, but their polarity is determined by the polarity of the element. Theodore M. Shapira.

Granit, Ragnar. **The mamalian colour modulators.** J. Neurophysiol. **11**:253-260, May, 1948.

The color thresholds have been determined for single spikes isolated in the cat's retina with the micro-electrode technique before and during polarization of the retina. The threshold is selectively altered in different regions of the spectrum by polarization. By dividing the threshold values before with those obtained during polarization a factor is obtained, called the "polarization factor," which illustrates the effects of polarization. The polarization factors, as functions of wave-length, reproduce the color modulators of the cat's eye.

The large effects of polarization on the light threshold have been shown to be due to specific structures for inhibition and facilitation and not to receptor effects. Hence the modulators obtained by plotting polarization factors against wave-length should be modified by such effects and need not represent primary color sensitivities. The modulators obtained by polarization agree in the main with those obtained by other methods. Hence modulator curves can be transformations of primary color curves by processes of facilitation and inhibition.

Theodore M. Shapira.

Groen, J. J., and Jongkees, L. B. W. **The threshold of angular perception.** J. Physiol. **107**:1-7, Jan., 1948.

The rotating chair, the torsion swing, and the after sensation time are the three different methods used by the authors to measure the threshold of angular acceleration perception. About 0.5°/sec. 2 is the minimum perceptible angular acceleration for man. The experiments of Mach (1875) yield the same result, if complete mechanical data are used. Mach's calculation, leading to a threshold value of 2°/ sec. 2 neglects the directional force and damping of the cupola.

Theodore M. Shapira.

Hirsch, M. J., and Weymouth, F. W. **Distance discrimination.** Arch. of Ophth. **39**:210-231, Feb., 1948.

This highly technical discussion is in two parts: (1) theoretic considerations and (2) effect on threshold of lateral separation of the test objects. The effect

of the separation of the rods on the threshold of distance discrimination was studied for five separations, ranging from 4 to 64 minutes.

The apparatus used employs the principle of Hering's Fallaparat and was designed to permit accurate fixation and to prevent ocular movements during observations. Over the range studied, the effect of separation is significant and systematic. The threshold is at a minimum at a separation of about 19 minutes and rises sharply at lesser and more slowly at greater separations.

John C. Long.

Hirsch, M. J., Horowitz, M. W., and Weymouth, F. W. **Distance discrimination. III. Effect of rod width on threshold.** Arch. Ophth. **39**:325-332, March, 1948.

With apparatus similar to the Howard test but with rods of different widths, the effect of incongruence between binocular parallax and size on distance discrimination was studied. The position of subjective equality was significantly affected in that it was shifted in the direction of size equality to an increasing degree by increasing the difference of width. The possible perceptual interpretation of this displacement is discussed.

Ralph W. Danielson.

Hirsch, M. J., Horowitz, M. W., Walker, E. L., and Weymouth, F. W. **Distance discrimination. IV. Effect of aniseikonic lenses on distance discrimination.** Arch. Ophth. **39**:333-338, March, 1948.

In this technical article, the authors report their study of the effect of size lenses on the position of subjective equality (E_s) and the standard deviation of the distribution.

Ralph W. Danielson.

Krimsky, E. **Effect of a prism on the corneal light reflex.** Arch. Ophth. **39**:351-370, March, 1948.

One is accustomed to think of a prism as a wedge-shaped piece of glass which bends a ray of light traversing it in the direction of its base. That this ray of light affects the position of the corneal light reflex in a paradoxic manner is not generally known. Displacement of a corneal light reflex from a fixational position is known to indicate ocular deviation, and any artificial method which could restore such displacement to a fixational position can likewise serve to register the amount of such deviation. Such artificial restoration by binocular instruments employing flexibly moving lighted targets through a measured range is established practice. That a corrective prism could likewise restore a displaced corneal light reflex to a fixational position was noted by the author in a previous report.

The author points out that the cornea is a convex spherical mirror. Hence, the corneal light reflex is an erect virtual image at the principal focus of the sphere. The corneal light reflex is misnamed because it is subcorneal in position and is 3 to 4 mm. behind the anterior surface of the cornea. It is technically a reflection. The prism displaces the corneal light reflex toward its apex in an eye which remains stationary. A small corneal light reflex is important for critical testing. The distance of a prism from the eye has an important bearing on its strength. Undue separation of the prism from the eye reduces its effectiveness by as much as 20 percent.

Ralph W. Danielson.

Karpe, G., and Tansley, K. **The relationship between the change in the electroretinogram and the subjective dark-adaptation curve.** J. Physiol. **107**:272-279, June 25, 1948.

Curves relating the size of the b-potential of the electroretinogram to the duration of dark adaptation were compared with subjective dark-adaptation curves taken simultaneously from the same eye. The b-potential curve showed a good agreement with the rod part of the subjective dark-adaptation curve if the electroretinogram stimulus was of moderate strength and the experiment preceded by an efficient light adaptation. There was also good agreement without the light adaptation if the electroretinogram stimulus was made strong enough, but in this case the two curves did not fit well after light adaptation. The b-potential reached its maximum too soon. The significance of the findings is discussed. (5 figures, references.) Bennett W. Muir.

Layton, A., and Olmsted, J. M. D. **Ocular refractive changes accompanying high blood sugar in alloxan-treated dogs.** Proc. Soc. Exper. Biol. and Med. **68**:257-259, June, 1948.

Hypermetropic refractive changes may occur in the eyes of alloxan-diabetic dogs at a time when the blood sugar level is rising or is high. The refractive changes were determined by retinoscopy while the animals were under nembutal anesthesia and atropine cycloplegia. Changes in the direction of myopia were not observed.
R. Grunfeld.

Lazich. B. M. **Amblyopia ex anopsia.** Arch. Ophth. **39**:183-192, Feb., 1948.

A new concept of the mechanism of amblyopia ex anopsia is presented. Amblyopia ex anopsia is believed to be poor vision due to malposition of the affected eye so that the visual ray is eccentric to the fovea. The degree of amblyopia varies with the deviation from the fovea. In support of this concept the deviation of the amblyopic eye is demonstrated by corneal reflections, and it is shown that there is greater acuity when the true visual axis is approximated, that eye-hand coördination favors the original visual axis, that the blindspot is displaced in the visual field, and that improvement in vision is much more rapid and more certain if treatment is directed to correction of the malprojection.

A procedure of treatment is outlined, with specific emphasis on the value of eye-hand coördination and of training devices which use intermittent illumination. The results of treatment are given in a few unusual cases. John C. Long.

Masson, S. **Bases for the laws of light.** Rev. oto-neuro-oftal. **23**:7-8, Jan.-March, 1948.

This paper is devoted to a description and definition of light, radiant and luminous flow, luminous intensity, international unit of candlepower, illumination, aperture, reflection, and similar entities.
Edward Saskin.

Miles, P. W. **Binocular refraction.** Am. J. Ophth. **31**:1460-1466, Nov., 1948. (2 figures, 3 references.)

Monje, M. **Examination of depth perception with the stereoeidometer.** Arch. f. Ophth. **148**:343-357, 1948.

The instrument uses the horizontal sagittal line between the pupils as an axis around which a disc can be turned. Three parallel small rods are situated in the plane of the disc. The middle rod can be shifted several millimeters forward or back from this plane. The most correct depth perception is obtained if the direction of the rods forms an angle with the horizontal line perpendicular to the axis. With a given displacement of the middle rod the size of the angle serves as a measure of depth perception and angles larger than 10° indicate subnormal functioning. Ernst Schmerl.

Nugent, M. W. **Corneal lens—new type of plastic contact lens.** Ann. West. Med. and Surg. **2**:241-244, June, 1948.

The author presents a preliminary report on a corneal contact lens. Wearing time appears to be considerably increased over the usual type of contact lens with scleral rim. The lenses are prescribed on the basis of measurements with the keratometer and fraction findings. Tears provide the necessary fluid. Orwyn H. Ellis.

O'Brien, J. M., and Bannon, R. E. **The fogging method of refraction.** Am. J. Ophth. **31**:1453-1459, Nov., 1948. (4 figures, 7 references.)

Orzalesi, F. **Variations of central and peripheral vision in emmetropia and ametropia related to recent developments of the theory of vision.** Boll. d'ocul. **27**:353-366, June, 1948.

The visual acuity of emmetropic eyes was measured at the center of the visual field and at 5, 10, and 15 degrees peripherally. The eyes were made artificially myopic with a convex lens of low power and the tests were repeated. The same tests were performed on eyes with a low degree of myopia. The data thus obtained are used to explain the central scotoma found by the author in certain types of aphacic eyes with secondary membranes.
K. W. Ascher.

Pascal, J. I. **The effect of mirror hole in retinoscopy.** Am. J. Optometry. **25**:92-94, Feb., 1948.

At the stage of neutralization the mirror and sight hole are sharply focused on the patient's retina. The image of the hole must be a dark area on the fundus from which no light emerges. Whence then comes the reflex? To the usual explanation of scatttered light due to irregular refraction and aberration may be added another factor, the formation of two different images on the retina. One is the image of the effective light source, the other is the image of the mirror itself. The two act in a sort of antagonism with reference to the image of the sight-hole.

When the light-source image is in sharp focus, the effect of the hole disappears. When the image is diffuse the sight-hole appears as a dark area. It is just the reverse in relation to the image of the mirror. As the two cannot be in focus at the same time the retinal image of the sight-hole is always illuminated. An analysis of the darkening effect of the hole on approaching neutralization shows that this is less when approaching neutralization from the "with" side with convex lenses than from the "against" side with concave lenses, which is why it is generally easier to neutralize from the "with" side. J. I. Pascal.

Pascal, J. I. **Emmetropia at near.** Optical J. and Rev. **85**:33-34, May 1, 1948.

The concept of emmetropia at near has been loosely used, but it has a definite connotation if by this is meant placing the ametropic at near in the same condition as the natural emmetrope is at near. For it can be shown by a study of the accommodative unit that the corrected ametrope does not see things at near with the same amount of accommodative effort as does the natural emmetrope. In order that he may behave like a natural emmetrope in near vision, his correcting lenses have to be modified. The corrected hyperope needs a stronger plus correction and the corrected myope needs a stronger minus correction. The increase in power depends upon several factors and varies with the distance of fixation.

The explanation for this fact is that the corrected ametrope has an accommodative unit which is not 1.00D. as it is in the natural emmetrope. It is more

than 1.00D. in hyperopia and less than 1.00D. in myopia. This affects also astigmatic corrections which have to be correspondingly increased for near vision. Note is also made of the effect of these changes on muscular imbalance for far and near and of the prismatic effect of correcting lenses in partly neutralizing these changes. (4 references.) J. I. Pascal.

Pascal, J. I. **Physiological basis of refractive errors.** Optometric World **36**:23-24, Jan., 1948.

Most refractive errors are due to differences in axial length rather than to differences in actual refractive power. But it is frequently more convenient to regard all refractive errors from a physiological standpoint, that is, myopia as an excess of power and hyperopia a deficiency of power. A puzzling point then arises. How can a lens placed in the anterior focal plane of the eye correct the error since the lens in this position does not change the refractive power of the eye? That is, the combined power of eye and correcting lens is the same as the power of the eye alone.

The answer is that the effect of the correcting lens is to shift the position of the principal points of the eye. A plus lens moves the principal points of the eye forward towards the cornea, a minus lens shifts them backwards towards the retina. The effect of the shifting of the principal points is to correct the ametropia even though the combined power of lens and eye is the same as that of the eye alone. J. I. Pascal.

Rubino, A., and Sapuppo, C. **The eye and the diencephalon. The reflex light sensitivity and the possible central influence on light sensitivity.** Riv. oto-neuro-oftal. **23**:170-180, May-June, 1948.

In ten normal subjects the authors found that light adaptation in one eye reflexly influences the light sensitivity of the other. (References.)

Melchiore Lombardo.

Sloane, A. E, **Refraction clinic.** Am. J. Ophth. **31**:1307-1309, Oct., 1948.

Stansbury, F. C. **Pathogenesis of myopia.** Arch. Ophth. **39**:273-299, March, 1948.

The author very adequately reviews the various theories that have been proposed, chief of which are excessive convergence, excessive accommodation, heredity, increased pressure of the intraocular fluids on bending the head forward, congestion of the coats, too short an optic nerve, congenital deficiency of the sclera, disorder of growth, imbalance of the extraocular muscles, psychic and intellectual relations, endocrine dysfunction, avitaminoses, constitutional diseases, biologic variation, and sclerochoroiditis.

Many classifications have been described, but the author suggests the very helpful division of primary, or physiologic, myopia and secondary, or pathologic, myopia. Primary myopia is a biologic variation of refraction and a healthy one. Secondary myopia is the result of disease of the coats of the eye; it should not be called myopia at all, but the term is proposed because of long established custom. It is believed that the large majority of cases are primary.

Ralph W. Danielson.

Steffens, L. F. **Some problems in refraction.** J. Iowa M. Soc. **38**:410-413, Sept., 1948.

Almost one half of the author's patients desired spectacles. He stresses the importance of a good history and of the proper use of cyloplegia and mydriasis.

He prefers the trial frame to the refractor. A discussion of the advantages of the use of the cross cylinder is given. He stresses the value of a muscle balance examination at 33 cm.

The indications for bifocal, trifocal, and occupational lenses are to be explained to the patient and he is then made to decide whether he desires them or not. An annual examination of the eyes is encouraged. A dissatisfied patient should be re-examined. A lensometer should be used to check the new glasses and it is important to note the optical center and the base curve. It is well to be aware of psychosomatic disorders.

H. C. Weinberg.

Van Wien, Stefan. **The influence of torsional movements on the axis of astigmatism.** Am. J. Ophth. **31**:1251-1260, Oct., 1948. (5 figures, 27 references.)

Wendland, J. P. **Effect of muscular exercise on dark adaptation.** Am. J. Ophth. **31**:1429-1436, Nov., 1948. (1 figure, 5 tables, 15 references.)

Zugsmith, G. S. **Use of coated lenses in retinoscopy.** Arch. Ophth. **39**:383-385, March, 1948.

Recent experience in reduction of reflection on coated camera and spectacle lenses suggested the use of coated trial case lenses in retinoscopy. A series of 100 patients were given retinoscopic examinations through coated and uncoated trial case lenses. There was closer correlation between trial case acceptance and retinoscopic corrections with coated lenses. The retinoscopic shadow was clearer, the side shadows were eliminated. The retinoscopic end point was easier to see. There was less complaint from the patient of discomfort due to brightness of the light. Ralph W. Danielson.

5

DIAGNOSIS AND THERAPY

Berens, C., and Luckiesh, M. **A tangent screen illuminator.** Arch. Ophth. **39**:176-182, Feb., 1948.

The instrument consists essentially of a hollow square with fluorescent lamps mounted in white channels. These are covered with a system of adjustable sliding louvers for varying the illumination. The illuminator provides uniform and variable illumination of from 1 to 100 foot candles. The quality of the light approximates daylight sufficiently for accurate testing with colored test objects. The apparatus is simple to operate and to maintain, and tedious calibration is minimized because of a built-in light meter. The fluorescent lamps generate a low intensity of heat.

John C. Long.

van Beuningen, E. G. A. **The influence of education in ophthalmological examinations.** Arch. f. Ophth. **148**:258-268, 1948.

The influence of education or any professional training upon the results of several subjective tests was studied in 612 persons. The visual acuity was determined by use of the v.Blaskowicz test chart, the depth perception was tested with the stereoeidometer (M. Monje), central and peripheral vision in dim light were examined with the Tschermak-Heinsius nyctoscope and Landolt's rings. With these tests 40 percent better visual acuity had to be ascribed to educational training. The results of the other tests seemed to be free from this influence. They gave a better representation of purely sensory functions.

Ernst Schmerl.

Gát, L. **Ophthalmic small bandages.** Am. J. Ophth. **31**:1306-1307, Oct., 1948. (2 figures.)

Hurwitz, Paul. **Antistine in ocular allergy.** Am. J. Ophth. **31**:1409-1421, Nov., 1948. (1 table, 10 references.)

Iliff, C. E. **Beta ray radium applicator for ocular use.** Arch. of Ophth. **38**:827-830, Dec., 1947.

A beta ray radium applicator for ocular use is presented. Its use as compared with that of the Burnam radon applicator is limited, but it has a striking advantage in that its durability is practically indefinite as compared with the fleeting half-life period of radon. Owing to the low potential and the surface fire, the use of the radium applicator is limited to treatment of vernal conjunctivitis, tuberculous sclerokeratitis and small tumors of the anterior segment and to the prevention of overgrowth of fibrous tissue. It is not useful in the occlusion of vessels.

John C. Long.

Katzin, H. M. **Improved scissors for corneal grafting.** Arch. of Ophth. **38**:832-834, Dec., 1947.

Scissors fashioned after Castroviejo's keratoplasty scissors were made with blades curved to correspond to the circumference of the round keratoplasty. They are made up of right-handed and left-handed curves, so that the operator need not move his position from the head of the table, and in a 5, 6 or 7-mm. diameter curve, depending on the size of the trephine used. These scissors make it possible to perform the entire corneal section without danger of injury to the lens.

John C. Long.

McBride, J. P. **The Berman foreign-body locator.** California Med. **69**:276-277, Oct. 1948.

The author reviews the literature and reports five cases. In these it was definitely shown that the Berman locator aids in the extraction of intraocular foreign bodies, both in localization and in reduction of trauma to the eye.

Orwyn H. Ellis.

Pallarés, J. **Therapy of herpetic ocular affections with parenteral injections of colloidal sulfur.** Arch. Soc. oftal hispano-am. **8**:699-709, July, 1948.

Pallarés tried sulfur therapy in herpetic diseases because sulfur baths were used for herpetic lesions since antiquity. Because ingested sulfur preparations are inactivated by oxidation with the gastric and intestinal juices, he decided to try parenteral administration. He injects 5 cc. of a 10-percent solution in distilled water intramuscularly. This form of therapy is contraindicated in patients with pulmonary or cardiorenal lesions. The injections are followed by a febrile reaction, similar to that which follows foreign protein injections. After one or two injections, the pain is alleviated, the epithelium regenerates, and the pupil dilates with atropine. Four to six injections usually suffice. Intravenous injections of a sulfur preparation were found just as efficacious, with the added advantage that local pain and constitutional reaction were avoided. The effectiveness of the intravenous administration proves that the therapeutic effect is not due to the febrile reaction. This treatment is indicated in all ocular diseases caused by a virus.

Ray K. Daily.

Šafář, Karl. **Electro-surgery on the eye.** Wien. Klin. Wchnschr. **60**:441-545, August 27, 1948.

Electrosurgery, or surgical diathermy is equivalent to electrocoagulation. Its many advantages include asepsis, slight bleeding, good scars, and relative painlessness. There are certain disadvantages, such as slow healing, injury to the lens and macula by overdosage, and the uncertainty of working with a sometimes unreliable

apparatus. Electrosurgery is useful in operations on the lids, where it is used as in all skin surgery, in operations on the tear duct and in enucleations to clean the socket of diseased tissue.

Electrosurgery on the eyeball will successfully remove tumors at the limbus, especially melanoblastoma, but, as the lens is very sensitive to heat, tumors of the iris must not be coagulated. Small growths on the sclera may be destroyed with electrocoagulation, but Šafář does not advise its use in pterygium, serpentic ulcer, or keratoconus. In scleral fistula and staphyloma the dosage must be kept low. Iridodialysis lends itself very well to electrocoagulation. Malignant growths should not be electrocoagulated unless they are seen early and occur in the only seeing eye because recurrences take place even after apparently successful treatment.

The greatest and most important field for electrocoagulation is in detachment of the retina. The author describes in detail the results obtained by him. They vary greatly, and are best in early, uncomplicated cases. Nursing care is important, and during the war results were poorer than in times of peace. If the eye remains well one or two years after operation, recurrence of the detachment is rare.

B. T. Haessler.

Salgado Benavides, Enrique. **Sulfotherapy of ocular tuberculosis.** Arch. Soc. oftal hispano-am. **8**:727-746, July, 1948.

In 1946 Xalabarder reported before the Valencia Academy of Science a new preparation of sulfur, a sodium trisulfate, known commercially as Triom, which, injected intravenously, was more effective therapeutically than the thiosulfates or sanocrisin. It appears to have a greater power of reduction than the thiosulfates, greater diffusion capacity, and more effective stimulation of the reticulo-endothelial system; it also reduces the resistance of acid-fast bacilli. A sufficient concentration of Triom must be maintained in the blood by frequent repetition of large doses. Salgado injects 10 cc. of a 10-percent solution daily, or more frequently if required. This article is based on experience in 20 cases of ulcerative conjunctivitis, scleroconjunctivitis, miliary chorioretinitis, iridochoroiditis in which the results of treatment were excellent. The treatment was ineffective in a case of retinal perivasculitis with vitreous hemorrhage. Five cases are briefly reported. The characteristic features of this form of therapy is rapidity of results, which sometimes are discernible after the first injection. Absence of improvement after the first twelve injections indicates that the drug is ineffective and its use should be discontinued. There were no symptoms of toxicity. Ray K. Daily.

Siniscal, A. A. **The Siniscal lid plate. A new instrument.** Am. J. Ophth. **31**: 1303-1305, Oct., 1948. (4 figures.)

6

OCULAR MOTILITY

Dunnington, J. H. **Some factors in the surgical treatment of vertical deviations.** Am. J. Ophth. **31**:1404-1408, Nov., 1948. (10 references.)

Fink, W. H. **Ligament of Lockwood in relation to surgery of the inferior oblique and inferior rectus muscles.** Arch. Ophth. **39**:371-382, March, 1948.

An anatomic study of the suspensory ligament of the eye, (ligament of Lockwood) based on a series of dissections, is presented. After presentation of illuminating drawings and discussion, the author concludes that the suspensory ligament of the eye (ligament of Lockwood), in addition to being a "suspensory hammock," is of importance to the clinician

because of its specialized functions in relation to the inferior oblique and the inferior rectus muscle.

From an anatomic standpoint, the surgical approach to the inferior oblique muscle should be at its insertion. Operation at the origin of the inferior oblique would produce more uncertain results because of the variable degree of fusion with the inferior rectus muscle at the point of crossing and would also tend to disturb the action of the check ligament, which is essential to an efficient action of the muscle. Operation at the origin of the inferior oblique muscle would also weaken and distort the check action on the inferior rectus muscle, an action which is dependent on a balance of pull between the inferior oblique muscle, from its crossing to its origin, and the check ligament of the inferior oblique muscle.

An ill advised surgical procedure not only may be ineffectual but may also cripple the action of more than one muscle. Ralph W. Danielson.

Giardini, Aniceto. **Considerations on a "pure" form of exterior nuclear chronic progressive ophthalmoplegia.** Riv. otoneuro-oftal. **23**:181-199, May-June, 1948.

A man, 44 years of age, first noticed symptoms of exterior ophthalmoplegia 20 years ago. They had progressed slowly but steadly so that at the time of examination the affected muscles were very limited in their action. No symptoms of interior ophthalmoplegia were present. The man was the first so affected in the family. No other neurologic signs were present and the laboratory tests were negative. The nature of the lesion, probably a primary myopathy is discussed at length. A bilateral correction of the ptosis by the method of Blaskovicz was followed by a severe bilateral keratitis and damage to vision. Concomitant paralysis of the superior rectus muscles prevented the rotation of the eyeballs upward during sleep. The writer points out that the lids should be raised surgically only enough to make useful unobstructed vision possible. Melchiore Lombardo.

Lord, M. P., and Wright, W. D. **Eye movements during monocular fixation.** Nature **162**:25-26, July 3, 1948.

A method of recording small movements during monocular fixation has been described by Lord, in which part of a beam of ultraviolet radiation that is incident on the cornea is reflected and its movements are recorded on film strips. The system is sufficiently sensitive to detect eye movements of one minute of arc.

The main feature which distinguishes eye movements during fixation from head movements on these records is the rapid flick lasting 0.02 to 0.03 seconds and indicating a momentary angular movement of the eye of amplitude ranging from 3 to 14 minutes of arc and an average frequency of 2 per second. There is little evidence of any fine vibratory movement having a period of the order of 0.02 seconds which has been discussed at length in connection with the resolving power of the eye. F. H. Haessler.

Mayou, Bertyl. **Treatment of amblyopia ex anopsia in strabismus.** Arq. brasil. de oftal **11**:31-39, 1948.

Miss Mayou, orthoptist to the Royal London Ophthalmic Hospital, reviews (in Portuguese translation) the well-known facts concerning the examination and diagnosis of this condition, together with a discussion of the importance of occlusion and of the types of case in which it can be undertaken. To produce satisfactory results, occlusion in very young children requires constant watch-

ing; and in school age the gibes of schoolmates must be combated as far as possible by enlisting the coöperation of the school teacher. The child should not be kept out of school. If treatment is begun early, normal vision may be secured. The outlook is much poorer when strabismus started early and the occlusion was initiated some years later. Cases of eccentric fixation do not respond well to occlusion, but it should be attempted in patients of five years or less and without discoverable pathologic change. There is scant prospect of success from occlusion in cases of high amblyopia in patients of seven years or more. Occlusion should not be attempted when the amblyopia is associated with nystagmus. Atropin is advised when correcting glasses are not worn. W. H. Crisp.

Ohm, J. **Latent nystagmus in one-sided congenital blindness.** Arch. f. Ophth. **14**: 318-330, 1948.

The author presents a case of congenital nystagmus which he studied with nystagmographic methods. To follow the author's presentation and interpretation the reader must be familiar with his former work, particularly his "Microneurologie des Auges und seiner Bewegungen" published in 1943.

Ernst Schmerl.

Owens, W. C. **Analysis of ocular motor anomalies.** Am. J. Ophth. **31**:1297-1301, Oct., 1948. (1 figure.)

Payne, B. F. **Operative treatment of vertical tropias.** Am. J. Ophth. **31**:1217-1222, Oct., 1948. (7 figures, 8 references.)

Prangen, A. deH. **Surgical treatment of imbalance of the extraocular muscles: physiologic aspects.** S. Cl. North America pp. 861-870, Aug., 1948.

Extraocular muscle surgery is done to restore function as well as to bring about cosmetic improvement. Repeated observations are necessary before operating because of frequent changes in the degree of imbalance. When the diagnosis is obvious and proper nonoperative management has failed, the operation should be performed without delay. In combined lateral and vertical defects the predominant defect should be corrected first.

The conjunctival incision should be clean and wide. Tenon's capsule should be utilized to prevent adhesions of muscle and tendon to the sclera. Anomalous conditions noted during the operation may necessitate an alteration of the operative plan. The author prefers to err on the side of overcorrection. He prefers the posterior approach for recession of the inferior oblique. Tendon transplantation is advised in rectus muscle paralysis. Orthoptic treatment is recommended but should be avoided where there is a persistent inability to obtain fusion since it fixes the diplopia and keeps the patient confused. Exact measurements should be used in altering tendon insertions. Plain gut sutures are preferable for scleral insertions. Intramuscular injection of boiled milk is useful in controlling undue postoperative reactions.

H. C. Weinberg.

Scobee, R. G. **Postoperative hypertropia.** Am. J. Ophth. **31**:1437-1440, Nov., 1948.

NEWS ITEMS

Edited by DONALD J. LYLE, M.D.
601 Union Trust Building, Cincinnati 2
News items should reach the editor by the 12th of the month

DEATHS

Dr. Thomas Francis Capeles, Haverhill, Massachusetts, died August 12, 1948, aged 63 years.

Dr. Webb Parks Chamberlain, Cleveland, Ohio, died July 20, 1948, aged 71 years.

Dr. Walter Frederick Johnson, New York, died July 13, 1948, aged 49 years.

Dr. Aquin Sarsfield Kelly, New York, died July 20, 1948, aged 71 years.

Dr. Heilner Maxwell Langdon, Philadelphia, died August 28, 1948, aged 72 years.

Dr. Philip Daniel O'Connor, Chicago, died September 5, 1948, aged 51 years.

MISCELLANEOUS

RESEARCH ASSOCIATION PAPERS

The annual meeting of the Association for Research in Ophthalmology, Inc., will be held at the Warwick Hotel in Philadelphia, Pennsylvania, June 6 and 7, 1949.

Authors desiring to present papers at this meeting should submit titles of their papers to Dr. James H. Allen, University Hospitals, Iowa City, Iowa.

SCHOENBERG LECTURE

The Mark J. Schoenberg Memorial Lecture was held at the New York Academy of Medicine on December 6th, under the joint sponsorship of the New York Society for Clinical Ophthalmology and the National Society for the Prevention of Blindness. Dr. John N. Evans, Brooklyn, discussed "Circulatory aspects of the glaucoma problem." This lectureship was established as a memorial to Dr. Schoenberg's interest and original work in the control of glaucoma.

On the committee in charge of arrangements for the meeting were: Dr. James W. Smith, chairman; Dr. Isadore Givner, Dr. Willis S. Knighton, and Dr. Franklin M. Foote. The lecture was preceded by an illustrated talk on "Observations on the anterior chamber angle with the gonioprism," by Dr. Harvey E. Thorpe, of Pittsburgh.

THE LANCASTER COURSE

The next course in the basic subjects of ophthalmology to be given under the supervision of the Ophthalmological Study Council will be known as the Lancaster course in honor of Dr. Walter B. Lancaster, who has been director of previous courses. Dr. Parker Heath, clinical professor of ophthalmology at the Harvard Medical School, will succeed Dr. Lancaster as director.

INTERNATIONAL CONGRESS TO MEET

The 16th International Congress of Ophthalmology will be held in London under the presidency of Sir Stewart Duke-Elder from July 17 to 21, 1950.

This is the first international congress to be held in 13 years, and it is hoped that it will serve to bring together a generation of ophthalmologists from many countries who have never met each other.

The international council have agreed upon two main discussions on the following subjects: (a) The role of the sympathetic system in the genesis of vascular hypertension and its effect upon the eye; (b) The clinical and social aspects of heredity in ophthalmology.

Those desirous of participating in the main discussions or reading communications on other ophthalmological subjects should communicate with Mr. Keith Lyle, International Congress of Ophthalmology, 45 Lincoln's Inn Fields, London, W.C. 2. English, French, and Spanish are the official languages. However, any language may be used.

Communications should not be longer than 2,500 words and will be read in an abridged form, for which the author will be allowed 10 minutes. On their submission, they should be accompanied by résumés, about 250 words in length, in the three official languages. Papers published before the congress are not acceptable. As the number submitted may be greater than can be accommodated, the publications committee reserves the right of rejection. In view of present printing difficulties, no guarantee can be given than any paper will be included in the official report of the congress unless it is received six months before the date of the meeting (by February, 1950).

Scientific demonstrations will be arranged, and there will be scientific and industrial exhibitions. Contributions to all of these will be welcomed.

ANNUAL CONGRESS

The annual congress of the Ophthalmological Society of the United Kingdom will be held at the Royal Society of Medicine, 1 Wimpole Street, London, W. 1, on March 31, April 1 and 2, 1949. The subject for discussion will be "Corneal grafting."

The discussion will be opened by Dr. R. Townley Paton of New York, Prof. A. Franceschetti of Geneva, Prof. G. P. Sourdille of Nantes, and Mr. J. W. Tudor Thomas of Cardiff.

Members who wish to take part in the subsequent discussion are advised to intimate their intention before the opening of the congress. It is emphasized that no member may speak for more than 10 minutes.

Royal College of Surgeons lectures

The following lectures in ophthalmology will be delivered at the Royal College of Surgeons, Lincoln's Inn Fields, London, W.C. 2. On March 29, 1949: "Cataract associated with lesions of the skin," by Prof. A. Franceschetti of the University of Geneva; and "Protein and amino-acid deficiencies in ophthalmology," by Prof. G. B. Bietti of Pavia University.

On March 30, 1949: "Psychosomatic symptoms in ophthalmology,'" by Prof. E. Hartman; and a paper by Prof. H. J. M. Weve, of Rijksuniversiteit, the subject of which will be announced later.

Receives grant

The Alabama Sight Conservation Association has made an additional grant of $4,300 to the Department of Ophthalmology of the Medical College of Alabama for the purchase of equipment and for assistance with the department's budget for technical services.

Societies

Brooklyn meeting

The Brooklyn Ophthalmological Society held its 106th regular meeting on December 16. Dr. Harold W. Brown discussed "Clinical aids in the diagnosis of strabismus," during the instruction session. The two papers of the evening were given by Dr. Raymond L. Pfeiffer on "Dermoids and epidermoids of the orbit," and Dr. John H. Bailey on "Metastatic adenocarcinoma of the choroid."

Central Illinois program

On November 12, 13, and 14, 1948, the Central Illinois Society of Ophthalmology and Otolaryngology held its 11th meeting at the Abraham Lincoln Hotel in Springfield. Dr. F. Bruce Fralick, professor of ophthalmology, University of Michigan, spoke on "Surgical anatomy of operations for glaucoma" and "Diseases of the tear duct." Dr. F. L. Lederer, professor and head of the department of Otolaryngology, University of Illinois, discussed "Modern approaches to the prevention and treatment of defective hearing" and "Malignancy in its relationship to nasal obstruction and hoarseness."

Two of the members of the society read papers —Dr. L. W. Roth, Belleville, Illinois, on the "O'Connor cinch operation," and Dr. D. K. Judd, Kankakee, on "Malignancies of the paranasal sinuses." Thomas W. Samuels, an attorney from Decatur, gave a talk on "A lawyer looks at the medical profession."

At the annual election these officers were elected for 1949: President, Dr. Clifton S. Turner, Peoria; president-elect, Dr. Harold Watkins, Bloomington; vice-president, Dr. Meredith Ostrom, Rock Island; secretary-treasurer, Dr. Philip R. McGrath, Peoria.

Milwaukee Society

The Milwaukee Oto-Ophthalmic Society held its regular meeting on November 23, 1948, at the Milwaukee Athletic Club. On the program were Dr. James E. Lebensohn, assistant professor of ophthalmology, Northwestern University Medical School, who spoke on "Bifocals," and Dr. Gerhard Straus, who presented a case report on "Bacillus proteus otitis media with multiple abscesses."

Reading programs

At the 85th meeting of the Reading Eye, Ear, Nose, and Throat Society on November 9, 1948, a symposium on "Aural pain" was given with Dr. Philip Wiest, Reading, Dr. Harold L. Strause, Reading, and Dr. Robert J. Hunter, Philadelphia, acting as members of the panel. At the 86th meeting on November 24, Dr. Philip Wiest discussed "The sphenopalatine ganglion."

Eastern Section Research Association Meets

The first meeting of the Eastern Section of the Association for Research in Ophthalmology, Inc., was held November 13, 1948, at the Einhorn Auditorium, Lenox Hill Hospital, New York City. The 184 members and guests registered enjoyed the following scientific program: "Ocular changes associated with scrub typhus," Dr. Harold G. Scheie and Dr. Wilfred E. Fry, Philadelphia; "Some biological problems in vision," Dr. Samuel Detwiler, New York; "Recent concepts in aqueous humor dynamics," Dr. V. Everett Kinsey, Boston; "A critical discussion of experimental exophthalmos," Dr. George K. Smelser, New York.

The attendance at the meeting was a tribute to the quality of the program as well as to the efforts of the sectional secretary, Dr. A. E. Braley, and his organizational committee.

Carolinas officers

At the Charleston meeting, the South Carolina Society of Ophthalmology and Otolaryngology elected Dr. Pierre G. Jenkins of Riverland Terrace as president and Dr. Roderick Macdonald of Rock Hill, secretary-treasurer. The North Carolina Eye, Ear, Nose and Throat Society elected Dr. James A. Harrill of Winston-Salem as president and Dr. MacLean B. Leath of High Point as secretary-treasurer.

Personal

Dr. Joseph I. Pascal has just returned from Europe where he participated in the scientific programs of the centennial congress of the Hungarian Ophthalmological Society in Budapest; the annual congress of the Swiss Ophthalmological Society in Zurich; and a regular session of the Ophthalmological Society of Paris. The papers presented were "A graphic study of the ocular muscles" and "A new static and dynamic muscle scheme."

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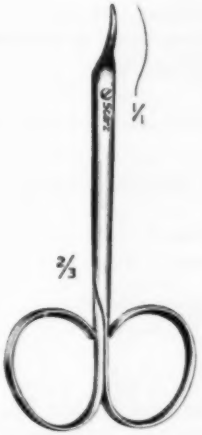

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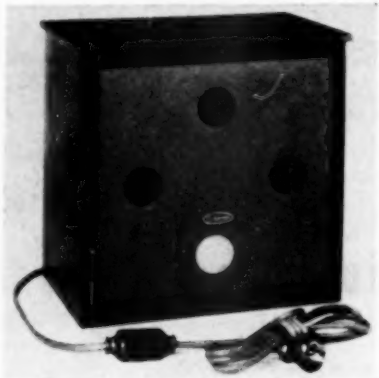

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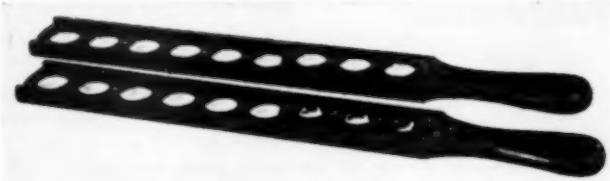

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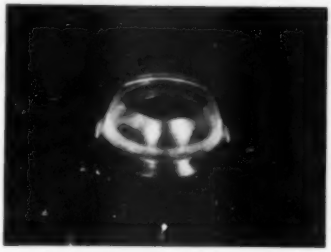

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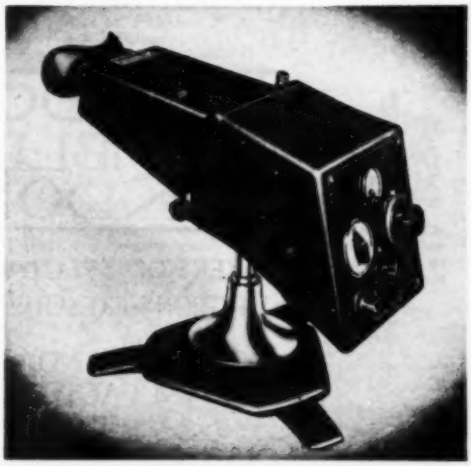

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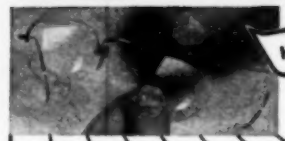

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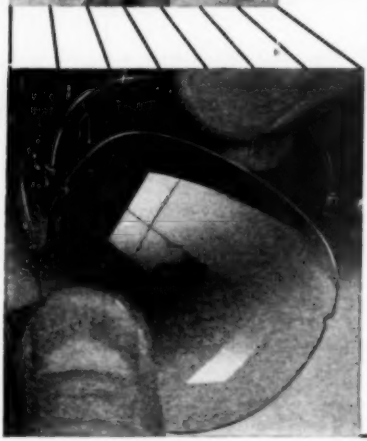

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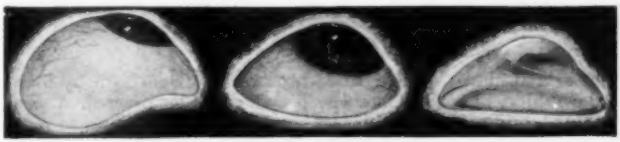

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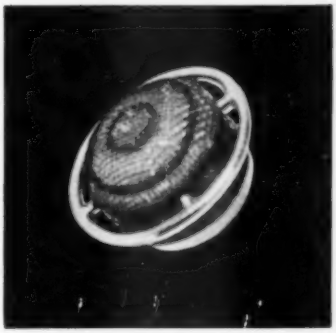

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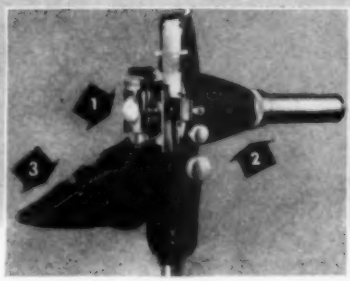

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